USSR Report

CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

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USSR REPORT

Cybernetics, Computers and Automation Technology

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GENERAL

AMERICAN CAPITALISM CRITICIZED FOR USE OF COMPUTERS

Kiev RABOCHAYA GAZETA in Russian 2 Jun 85 p 3

[Article by D. Vydrin: "The Romance of Capitalism With the Computer:
American Propaganda in Search of an Electronic Wonder-Worker"]

[Text] An "event" has occurred in America—the price of so-called personal
computers has been reduced. This fact hardly caused delight and enthusiasm
among ordinary Americans and hardly attracted their attention. How could one
be glad if a decrease of prices for microprocessors coincided with the next
rise of costs for an apartment, everyday services and food products. More-
over, pragmatic Americans fully understand that regardless of how much one
increases calculation of the family budget by using electronics, it will not
increase because of this and debts will not be reduced. Of course, this pri-
marily concerns ordinary citizens of the richest capitalist country.

The unusual uproar raised by official American propaganda organizations
appears even more remarkable on the background of this indifferent reaction of
most, beginning with the propaganda advertisement of America magazine and
ending with the respectable journal Fortune. The fact is that the leading
electronics companies, Atari, Commodore and Texas Instruments, announced the
decrease of prices for personal computers from $200 to $99. One asks what the
relationship of bourgeois propaganda to microprocessor technology is? What is
a computer to it? Moreover, the secret of the attention and unexpected pas-
sion of American ideologues to the advances of microelectronics is very simple
to analyze. They saw in the computer that which they had dreamed of in their
most optimistic dreams for many generations of steadfast defenders of the
bourgeois form of life and namely a long-awaited weapon that, they feel, would
be capable of reducing the class struggle to nothing.

The basic positions which bourgeois propaganda formulated by using references
to the book, "The Third Wave," by the American sociologist Toffler, much
talked about in the west, and to articles of futurologist I. Wilson, the cal-
culations of the English economist N. McCray and other theoreticians of the
"computer age," reduced to the following: so-called production collectives
will disappear in the near future as a result of mass distribution of the com-
puter "cottage industry." Workers connected by their personal computers to
the automated production management system, without going from their comfort-
able suburban homes, drinking beer or coffee, will manage the robots making

the machines, baking the bread or smelting the steel hundreds of miles from them. And since there will be no collectives, there will be no collectivist consciousness and no main political and sociopsychological features of the working class.

All-powerful and ruthless personal computers, in the opinion of bourgeois propaganda, will eliminate not only production collectives but even political parties. These parties are created to clarify the interests of specific classes and social layers. Now there will be no need for these organizations. American society will seemingly be converted "from a system of democratic representation to one of democratic collaboration in managing the country." That is, each American will be able to assert his own interests and dictate his requirements to the government not by belonging to some party and through the corresponding activity, but exclusively through his own computer, making it the "collaborator" of the government itself. Computer communications with the central government organizations will make direct participation of everyone in "decision-making at all levels" possible.

And another thing: as American ideologues state, the computer will make that sphere of the country's life scripturally valid, due to which class conflicts have occurred especially frequently of late, and namely: social security for all citizens. Regardless of what class struggle there is, the "computer makes it possible to define more accurately the conditions of insurance, retirement security and so on for each individual employee according to his desires and needs. This programming requires a number of the most complicated computations, unthinkable without the use of computers."

Finally, electronic technology gives equal opportunity to all members of society, from the millionaire to the messenger, to gain access to the treasuries of national and world spiritual culture. The computer plus cable television makes it possible for users to communicate with all libraries, museums, funds and miscellaneous repositories of the achievements of the human spirit.

This is briefly the picture of the social consequences of total computerization, drawn by official American propaganda. And, one must recognize that the picture is very impressive. It is impressive primarily because of the fact that its creators have tied into a single bundle almost the entire "gentlemen's collection" of the traditional methods of western ideology: quasi-scientific methods of social research and various types of trick shuffling and omissions. The well-loved procedure of the bourgeois specialists in social questions—manipulation of the method by simple extrapolation—plays an appreciable role in this varied collection. Its essence is not too complicated. Imagining that some phenomenon from social life will develop in the same direction at current rates, the specialists make conclusions about its future status on this basis.

Numerous examples of using this procedure can be cited in bourgeois apologetics. Let's take one of them. It was established during mass postwar questionnaires that the number of Americans from 1946 through 1949 who regarded themselves as happy increased from 39 to 43 percent. Thus followed the

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conclusion, which began to be advertised, that absolutely everyone will be happy in the United States by the 1980s (current figures indicate how accurate the given forecast is. Less than one-third of Americans call themselves happy and the number of these is decreasing continuously).

The logic of the arguments of computer proponents is absolutely identical to the logic of the oracles of the "happy America." The idyllic picture of the computer "cottage industry" is being constructed on the falsely interpreted local fact of experiments of only some design and architectural companies. To talk about conversion of all capitalist production to these conflictless "non-collective" forms is absolutely untrue.

Capitalism as a socioeconomic system has its own specific "alter ego"—the other self. This is large machine production, which reached an apogee in con-veyors—"sweatshops." Automata, computers and robots—these new sacred ideo-logues of capitalism—do not in fact belong to this system and moreover do not protect it. On the contrary, they are mortal enemies of capitalism since dis-tribution of them will inevitably aggravate imperialist contradictions. Introduction of microelectronic wonders into industry has resulted in forma-tion of 30 million workstations in the leading western countries during the past decade and at the same time has made more than 35 million workers unnec-essary. That is, the shadow of a minimum of one unemployed having no job, no personal computer and no home in general looms behind the back of each compu-ter "home worker."

Another paradox of capitalism is manifested in the fact that introduction of the new technology has brought many enterprises to the edge of bankruptcy in the 1980s. For example, modernization of General Motors almost resulted in collapse of it. It was saved, as always, at the expense of workers: the wages of more than 300,000 workers were frozen last year and their vacations were reduced by 9 days. At the same time, semicottage enterprises have now gotten a second breath with seemingly long obsolete technology and traditional methods of exploitation: hard driving, fines, shouting of foremen—and no electronics of any kind. It turned out that computerized and automated plants with too high capital and material consumption lose in the part of profit to classical "sweatshops" with cheap manual labor.

The ideas that computers are capable of eliminating political parties are absurd. One can state on the same basis that the recent installation of elec-tronic voting machines makes the election of American presidents more demo-cratic. Among the strategic elite in the United States—among those who are at the apex of politics in the country, the following slogan has long existed: "To share authority means to lose it." And naturally the elite does not plan to share its real authority with millions of simple Americans. It is another thing to provide them with the illusion of participation in government affairs. What are promises worth that "elevation" of Americans (even if nothing comes of it) to the ruling organizations through the computer alter somewhat the structure of political power and the forms and methods of con-trolling this power?

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The promises of fair social security of Americans through accounting technology are quite absurd. It has become a custom in the United States to compare the national income to Christmas pie. A piece of this pie, cut for Americans in the form of social programs, is being reduced more rapidly by the current administration than a cowboy drawing his Colt 45. Appropriations for social needs have been cut by $40 billion during the past few years. Expenditures on food stamps for the hungry have been reduced by 30 percent and expenditures on health care have been cut almost in half. So that regardless of how validly computers distributed the remaining crumbs among the needy, they would hardly be satiated with this.

In view of the foregoing, the colors with which the ordinary American, who enjoys art masterpieces at home, is drawn are growing dim. Karl Marx noted: "Loaded down with cares, the needy person is insensitive even with respect to his own excellent appearance." And obviously tens of millions of Americans, living below the poverty level, under conditions of chronic malnourishment and with constant concerns about tomorrow, hardly have the desire to create Babylonian sculptures or Flemish paintings on their display screens. One can add to this that capitalism is vitally interested in cultivating the maximum ignorance among the workers. Millions of adults are illiterate in the United States—the most developed capitalist country. What is it to them, not knowing how to sign their name, to order masterpieces of world literature in the original on the computer?

History indicates that there is no technical advance which capitalism has not attempted to use against the workers. "Winged missiles were invented in the United States by the use of computers and computers provided the thrust to develop space weapons and other types of weapons of mass destruction. It is their use that has made possible a system of total espionage beyond the borders of the country. Complexes are now being tested, due to which absolutely all telephone conversations of all "free" citizens of the western world will be monitored and analyzed. Even the visionary appearances of senators were shaken when they learned of the scale of penetration of electronic fingers of the special services into the private lives of Americans. One of the congressional reports states: "The combination of complicated data acquisition hardware and storage of it using computers has created a quite realistic danger that the feeling of confidentiality, which served as the traditional security of Americans against the fear of intrusion of the government into their personal lives, will be destroyed and instead there will appear the ever penetrating sensation of being shadowed."

These are the true, rather than the illusory fruits of the romance of capitalism with the computer.

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PROBLEMS IN ACCEPTANCE OF COMPUTERS REPORTED

Moscow LITERATURNAYA GAZETA in Russian 12 Jun 85 p 11

[Article by V. Piven, chief of Main Information Computer Center, Ukrainian SSR Central Statistical Administration, Donetsk Oblast entitled: "Stepchildren?... Daily Life of a Computer Center" under the rubric "Man-Computer-Society" in a section "Opinions, Facts, Commentaries."]

[Text] Since the invention of the steam engine, the nature of human labor has not changed as radically as it was transformed with introduction of computer technology. I feel that readers will express many opinions about the problems accompanying the development of the computer industry. This is really an industry! Millions of people have been drawn into activity directly related to computers.

Besides the Main Information Computer Center, Central Statistical Administration (GIVTs TsSU USSR), there are three additional computer centers in our town of Artemovsk, a small town with population of 90,000 persons: at the Nonferrous Metalworking Plant imeni E. I. Kviring (Mintsvetmet SSSR [USSR Ministry of Nonferrous Metallurgy]), at VKBsol [not further identified] (Minpishcheprom SSSR [USSR Ministry of the Food Industry]) and at the Association Donbassgeologiya. But the departments do not fully load the computer: after all, computer centers do not participate in the production process of their plants, but only process economic, statistical and bookkeeping data.

However, they have not achieved perfection even in this. The matter amounts to a curiosity. Let us say, the Plant imeni E. I. Kviring has for more than 10 years calculated the wages for its workers at our computer center, although the plant has a Minsk-32 computer, with which it could do even more complicated calculations.

The municipal authorities have tried to force the owners of the computer hardware to utilize it more intensively. But even today the expensive machines are not loaded to full capacity.

What can be said about the hardware purchased by other small enterprises? It is generally idle. Billing machines from the GDR have been lying in their crates still unpacked for several years at the electrical engineering plant. We requested that they trade the equipment to us on an even par, but they refused—this is not the right department. Computers are gathering dust at pharmaceutical and other warehouses and they are standing idle at the petroleum

depot and factory. The same situation exists at Artemovsk. I consulted with colleagues from other towns and republics and the story is the same. Instead of normative loads, the computers are loaded one-half as much. Why is this? There is nothing to consider. Why did they purchase them? They say: "They were given to us by allocation."

It is known that a simple computer costs 35-75 rubles per hour. But what is hidden behind this cost? The computers are not disconnected from the power system during idle times: switching it on and off produces surges and voltage drops which instantaneously cause integrated microcircuits to fail. And this means repair, debugging and again expenditure of funds and time of specialists. While a computer is idle, it still draws 15-20 kilowatts of electric power per hour. If the losses throughout the country as a whole are counted, it turns out that a large electric power plant is operating at idle.

The conclusion suggests itself: the principle of disbursing computer hardware must be reviewed. The return without investing additional monies can be improved considerably in our still undeveloped sector. But this sector itself must be primarily organized, having eliminated the dispersion of its shops, now included in different departments.

One may object: after all, I am fighting for collectivization, although our agency, the Central Statistical Administration, has concentrated an enormous amount of computer hardware in itself. Indeed, multiuser computer centers for rayons, cities and republics began to be created in this system during the early days. But the capacity and stock of computers has increased so much during the past few years that computer hardware has become bigish for a single department. The share of data to be processed on this equipment for management organizations has decreased. For example, work worth approximately 300,000 rubles was completed in 1983 by the Artemovsk Computer Center for different enterprises, organizations and institutions. But the work for the Central Statistical Administration itself was only worth 150,000 rubles. The fraction of services for the department to which the computer center is related actually comprises only 1.5 percent. In this case, can it become the unifying host of a sector which produces a specific product—information? Hardly.

There are also other factors that show that the output of information cannot be trusted only to the Central Statistical Administration, or only to any of the presently existing departments, even though they have computers. Management of computer hardware assumes intelligent use of it, planning for further development and improvement and provision with material and technical funds and personnel. What can chemists, machine builders, power engineers and statisticians know about development of universal programs for computers and about the trends in development of the hardware itself? They say to us: manifest creative activity, independence and initiative. But what really happens. The number of staff positions has been cut by 17 persons at the municipal planning center of the Central Statistical Administration as a direct order, without considering the norms. This management decision cannot be recognized as intelligent, because reduction of ITR [engineering and technical personnel] and workers leads to disruption of the maintenance schedules of the machines, idle times of equipment and disruption of the deadlines for issuing report data to clients.

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Since it is not the electronic engineers and programmers, but specialists far removed from our problems, who formally manage the computer center, there is a poor supply of spare parts, assemblies and equipment. Let me illustrate by an example.

In 1983, according to the plan, we were supposed to receive 10,000 running meters of paper with edge perforation, but we somehow did not receive it.

The computer center then found it necessary to purchase four billing machines. This was reported in the oblast statistical administration. It was requested of the Ukrainian SSR Central Statistical Administration. They answered that there are no funds. We do not even have a room air conditioner and as it turns out we do not have the right to purchase one. A second complex was started up for preparation of data on magnetic disk at a cost of 32,000 rubles. An electrical engineer is suggested for this according to instructions. But we were refused. This is how our "independence," ended. Instead of independence, restriction of rights and funds dominates. The chief cannot create suitable conditions for his own workers: to increase wages and to provide housing. And after all it is our specialists who are at the front of scientific and technical progress. Without them, it would not be possible today to provide automation and mechanization and intensification of engineering work and management.

The most modern equipment cannot operate intensively toward technical progress if it is managed by an outside department. The activity of the computer center is now estimated at how many hours the computers are operating. They operate for 20 hours, this is good. If they operate 8 hours, this is bad. This is the view of the Central Statistical Administration. But this is a senseless transfer of information: the computer center counts the data of the same plant which must report to the ministry, local authorities and to the central statistical administration.

The same information is counted three times! If one works from state positions the work of the computer center must be evaluated differently: if efficient operation is required of the computers, let the computer cope with the posed task within 7 rather than within 20 hours. "Improvement" of the economic indicators does not at present reflect the fact that the computer center is using its own poor programs and is bringing up the rear of the scientific and technical revolution.

Information is the same type of national strategic resource as mineral raw material, electric power and transport. The enterprises have long used these resources without becoming involved in the problems of production and distribution of them. Let us say that some plant, institute or design office requests power of several hundred kilowatts and Minenergo [Ministry of Power and Electrification] considers the application: where there are surpluses in the city, a transformer will be installed or cable will be laid as use time provides. They advise us: let the institute conduct experiments at 0300, since the public need for electric power decreases sharply during this time of the day.

Output of information should also be accomplished by demand. The enterprises express their needs. Provision of an information product, the quantity and quality of it and the efficiency of solving problems all should be an indicator of operation of the computer center.

The computer centers at their own enterprises should possibly solve production problems for each plant. Part of the equipment can probably be left at academic institutes where there are highly qualified specialists. But computer units, which process accounting, bookkeeping and statistical data are underloaded, as has been established according to norms, cannot be left in the current state. This is careless and inefficient.

Who will unite them in the sector is not the main thing. But that this department appears and organizes affairs on a centralized basis, relying on cost accounting in the interests of the state, is the essence of the matter.

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HARDWARE

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METHOD OF INCREASING EFFICIENCY OF MEMORIES BASED ON PROGRAMMABLE ROM
MICROCIRCUITS

[Article by Candidate of Technical Sciences V. V. Borisenko, Candidate of
Technical Sciences V. I. Korneychuk, Candidate of Technical Sciences V. Ya.
Yurchishin and engineer I. A. Dichka]

[Text] Semiconductor read-only memories (PZU), programmable by the user [1],
have now become widespread. However, the microcircuits of programmable ROM,
produced by industry [2], have a low programmability factor k, equal to the
ratio of the number of microcircuits, the information in which fully corre-
sponds to the write program, to the total number of microcircuits taken for
programming (k is determined as the mean statistical value and is assumed
constant for a specific type of microcircuits) [3].

A circuit is described below (Figure 1) that permits one to substitute ROM
cells, the contents of which does not correspond to the information written in
them. The use of this circuit permits one to decrease considerably the rejec-
tion of microcircuits. Information in the cell of the main ROM (ПЗУ-0) is
arbitrarily divided into groups of bits (syllables). Defective syllables of
ПЗУ-0 cells are replaced by syllables stored in ПЗУ-1 (a syllable differing
from that written in at least one bit is called defective), while ПЗУ-2 and
ПЗУ-3 are used to determine the location of the substitution. To do this, the
high order bits of the address of the CPA cell, in which the substitution must
be made, are written in ПЗУ-3 by the address, formed, for example, from low-
order address bits MPA of ПЗУ-0 cell, while the number of the syllable to be
substituted is written in similar fashion in ПЗУ-2. The number of the
syllable is decoded by a decoder Д and, if the CPA cells coincide with the
code read from ПЗУ-3 (this is determined by the comparison circuit CC), then
the defective syllable of ПЗУ-0 cell is replaced by means of a commutator К by
a syllable of the selected ПЗУ-1 cell.

Let ПЗУ-0 have capacity of 4K 32-bit words and let it be constructed on micro-
circuits with capacity of 256 4-bit words. The capacity of ПЗУ-1, ПЗУ-2 and
ПЗУ-3 is 256 4-bit words each. The information in ПЗУ-0 cell is divided into
8 syllables of 4 bits each. Let us assume that there are defective syllables,
the numbers of which are 1, 3, 4 and 8, respectively (each noted cell contains

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one each defective syllable), in ПЗУ-0 cells with addresses A_1-100110011111, A_2-101100110110, A_3-110110100110 and A_4-001011010010. The information used to replace the defective syllables in the indicated ПЗУ-0 cells, is written in ПЗУ-1 by the addresses a_1-10011111, a_2-00110110, a_3-10100110 and a_4-11010010, codes 0001, 0011, 0100 and 1000 are written by the same addresses in ПЗУ-2 and codes 1001, 1011, 1101 and 0010, respectively, are written in ПЗУ-3. Access to addresses a_1, a_2, a_3 and a_4 of ПЗУ-1, ПЗУ-2 and ПЗУ-3 occurs upon access to the indicated addresses A_1, A_2, A_3 and A_4 of ПЗУ-0. ПЗУ -3 issues the CPA code, the CC authorizes decoding of the number of the syllable subject to substitution, while the commutator substitutes the defective syllable of ПЗУ-0 cell with the syllable read from ПЗУ-1. Thus, three additional microcircuits make it possible to substitute 256 4-bit defective syllables in ПЗУ-0, constructed on 128 microcircuits, in the considered example.
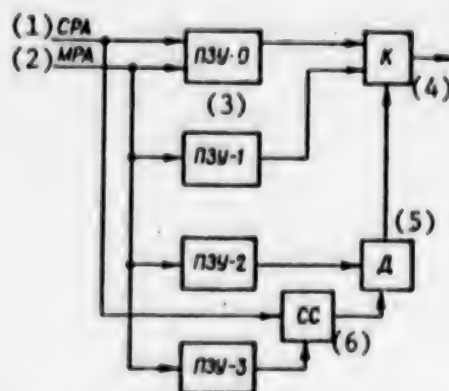
Figure 1.   Block Diagram of ROM with Substitution of Failed
            Syllables of Cells

Key:
1. High-order address bit   4. Commutator
2. Low-order address bit   5. Decoder
3. Read-only memory   6. Comparison circuit

When constructing the ПЗУ-0 from microcircuits, it is convenient to make the substitution with syllables whose length is equal to the length of the micro-circuit cell. Then, the entire system should not contain two or more micro-circuits having defects in cells of the same type. To fulfill this condition, the ROM should be constructed by sequential selection of the microcircuits. Let us assume that ПЗУ-0 must be formulated from N microcircuits. One micro-circuit each with capacity s of r-bit words is used for each ROM (1-3). The series of microcircuits to be used is characterized by programmability factor k. If one assumes that failures of the memory elements (ЭЭ) are independent and their distribution is subject to binomial law, then the probability of a failure-free state of one memory element of the microcircuit is $w = \sqrt[s]{k}$. The probability of a failure-free state of one cell is $p = w^r$, while the probability that the microcircuit contains no more than m failed cells is

$$Q(m) = \sum_{j=0}^{m} C_s^j p^{s-j} (1 - p)^j.$$

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A considerable number of microcircuits contains no more than one failed cell. Thus, $Q(1) = 0.906$ at $s = 256$, $r = 4$ and $k = 0.6$ (the usual value for ROM microcircuits).

The probability W that one will be able to construct an ROM from any $N + 3$ selected microcircuits is determined by the formula

$$W = \sum_{i=2}^{N+3} C_{N+3}^{N+3-i} k^{N+3-i} (1-k)^i P_i,$$

where P_1 is the probability that no defective cells of the same type exist in i microcircuits, containing failures and used for construction of the ROM. For $i = 2$

$$P_2 = \frac{C_s^1 C_{s-1}^1}{(C_s^1)^2} = \frac{s-1}{s},$$

then,

$$P_i = \frac{\prod_{z=1}^{i-1}(s-z)}{s^{i-1}}, \quad i = 2 \div N + 3.$$

The effective programmability factor $k_{\ni\phi}$ for the proposed circuit is determined as

$$k_{\ni\phi} = \frac{N}{N+3} \sqrt[N+3]{W}.$$

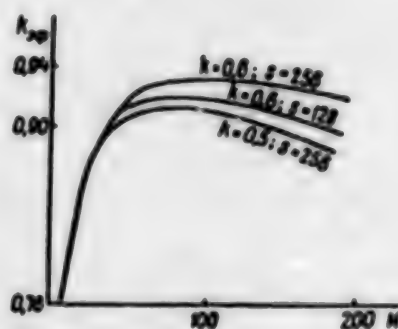The dependence of $k_{\ni\phi}(N)$ for some values of k and s is presented in Figure 2.

Figure 2. Dependence of $k_{\ni\phi}(N)$

To program an ROM with capacity of N microcircuits, one must use on the average $M = \left] \frac{N+3}{\sqrt[N+3]{W}} \right[$ microcircuits, where $]x[$ is the nearest integer not less than

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x, while X corresponds to a specific value of N. For example, an average of 24 microcircuits is required at k = 0.6 and s = 256 to construct a unit in which ПЗУ-0 consists of 20 microcircuits (construction of the ROM consists in programming and selection of the microcircuits so that their defective cells are of different types).

Defective microcircuits, which cannot be used in manufacture of some unit, are not rejected during serial production, but are used to manufacture other units, which contributes to a considerable saving of microcircuits. Let the production program comprise T read-only memories, while the capacity of ПЗУ-0 is equal to N microcircuits. An average of $n_1 - \left] T \dfrac{N}{k} \right[$ microcircuits would be required to manufacture this number of units by the traditional method.

According to the proposed method, N different classes of microcircuits i programmed on standard equipment to manufacture this lot of units. Each class contains microcircuits in which identical information is written. The sets are made up in the following manner. Using a computer, the microcircuit of the first class is compared to a standard and is installed on a card. If the microcircuit has defective cells, the numbers of these cells are stored and a defect field is formed, while the information required for substitution is entered into the corresponding cells of three backup microcircuits. One proceeds in similar fashion with microcircuits of the remaining classes, but they are installed on the card only if the numbers of the defective cells do not coincide with a single one of the numbers written in the defective field. If there is at least one match, the microcircuit is returned to its own class, from which another microcircuit is taken and is subjected to the same operations. Thus, the procedure is repeated until the microcircuit from the considered class is installed on the card. Making up the unit is completed after selection of a microcircuit from the N-th class. The card of the next unit is then filled. The selected microcircuit is returned to its own class after each unsuccessful test and is used in making up the next unit. If a defect appears in one of the microcircuits upon writing the substituting information into the backups, the microcircuit installed on the card is returned to its own class, the numbers of the defective cells belonging to this microcircuit are erased in the defect field and the number of the defective cell of the backup microcircuit is written in the defect field. Microcircuits from the same class are then selected repeatedly. Thus, the considered scheme permits one to use the same microcircuits as additional read-only memories as for the main read-only memory, i.e., those containing defects.

An average of $n_2 - (T-1)(N+3) + \left] \dfrac{N+3}{\frac{N+1}{\sqrt{N}}} \right[$ microcircuits is required to manufacture T units according to the proposed method. The serial magnification factor is then $\gamma = n_1/n_2$. At sufficiently large values of T and N, $n_2 \simeq T(N + 3)$ and $\gamma = 1/k$.

The proposed method of substituting defective ROM cells permits a significant increase of the programmability factor of microcircuits. It is realized in the read-only memory of SM computer microinstructions, produced by the PO [Production Association] Elektronmash (Kiev), and may find broad application in construction of read-only memories for control units.

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YES-1046 COMPUTER WITH LONG-DISTANCE SERVICING SYSTEM

Moscow KOMMUNIST 7 July 85 p 1

MUSAELYAN, V.

[Excerpt] As has been reported, the model YES-1046 computer was accepted by a state commission in the fall of last year and recommended for introduction. This new computer is now undergoing trials by an international commission.

The 'star attraction'—the YES-1046 computer—has been operating for two days straight in a computer room of the Yerevan Scientific Research Institute of the Yerevan Scientific Research Institute of Mathematical Machines (YerNIIMM); 'without resting,' so to speak, it has been solving problems in accordance with a program developed for this purpose. A rigorous test is in progress.

A long-distance servicing system for computers, which makes it unnecessary to keep highly skilled maintenance personnel on hand at a particular computer center, has been developed for the first time in Soviet practice. With it, a large number of computers can be serviced from a single remote center. A service processor takes the place of a mechanical control desk in the new computer. This processor allows the operation of the computer to be improved substantially.

Personnel of the departments in which the processor and the operational subsystem for the computer were developed, under the direction of Kh. Sharoyan and I. Mkrtumyan, performed great services in the development of the new-model computer. An online storage was introduced under the direction of L. Chakhoyan. A. Berberyan directed the development of the service processor, and S. Shukhuryan directed the development of microprogram support—applied programs. The chief designer of the YES-1046 was A. Kuchukyan, a Lenin Prize laureate.

The YES-1046 computer is beginning its career. Its series production has begun, and it will shortly appear at computer centers of the USSR and of member-countries of the Council for Mutual Economic Aid.

(A photograph is given showing three associates of YerNIIMM—senior engineers N. Pogosyan and K. Pogosyan, and engineer K. Manukyan—working with the YES-1046.)

FTD/SNAP
CSO: 1863/385

"MARS" SUPERCOMPUTER BEING DEVELOPED BY INTERDISCIPLINARY GROUP

Tallin SOVETSKAYA ESTONIYA in Russian 2 Jul 85 p 1

ZAKHAROV, K.

[Excerpt] "Start" is the name that has been given to a temporary scientific and technical organization which has been created at the Computer Center of the USSR Academy of Sciences' Siberian Branch, the Estonian Academy of Sciences' Institute of Cybernetics, the USSR Academy of Sciences' Computer Center, and the "Impul's" Research and Production Association of the USSR Ministry of Instrument Building, Means of Automation and Control Systems. The organization's purpose is the perfection and experimental testing of elements of the concept of fifth-generation computers, and the building of an experimental model of a supercomputer called "Mars". We asked Candidate of Physical-Mathematical Sciences Aleksandr Gur'yevich Marchuk, the organization's deputy head, to tell us about the work of "Start":

"Naturally, the development of a computer with new architecture and with up-to-date software was preceded by much work in various fields of information science. Our 'Mars' experimental model must be completed by 1988.

"Scientific talent for the solution of this problem was chosen according to the principle of specialization. Temporary organizations are capable of solving urgent technological problems in a short time. This is why the USSR State Committee for Science and Technology and the presidium of the USSR Academy of Sciences decided to establish the temporary scientific and technical organization 'Start'. Novosibirsk specialists have undertaken the development of the processors, the operating systems, and part of the programming systems—in short, the basic architecture of the system. It is up to the Moscow specialists to develop the software for individual work stations—the work places of specialists in various branches of the economy, who will become users and subscribers of the new computers. Estonian cyberneticists are solving one of the most complex problems—they are developing programming systems which will make it possible to generate the most diverse packages of applications programs necessary for the control of the entire complex and for making the entire 'Mars' system "intelligent."

"The system will be able to respond to both audio and video information and will learn how to improve itself and how to help human users in this.

"To make a comparison, the present work in the field of computer technology
in many ways is similar to the solution of problems of space flight.
An accelerated solution, let me note. 'Start' has been allotted considerable
funds for contract work by various ministries, and this is bound to help over-
come obstacles between agencies."

(Photographs are given showing Enn Tyugu, academician-secretary of the
Estonian Academy of Sciences' recently established information science and
technical physics department, and members of the Tallin group of "Start":
section heads of the Estonian Academy of Sciences' Institute of Cybernetics
Akhto Kal'ya, Aleksandr Shmundak, Ants Urvak and Mikhail Matskin, and
science associate Mari Kypp.)

FTD/SNAP
CSO: 1863/385

DEVELOPMENTS IN COMPUTER RESEARCH LABORATORIES REPORTED

Moscow SOVETSKAYA ROSSIYA in Russian 21 Jun 85 p 4

[Article by Igor Ognev, Novosibirsk-Moscow: "What a Magician You Are, Chip!"]

[Excerpt] Less and Less

Blaise Pascal needed all the knowledge accumulated by mankind on geometry, physics and mechanics to develop his arithmetic machine.

"The appearance of microelectronic devices," says Ye. Cherepov, "would hardly have been possible without understanding the physics of the semiconductor surface."

Study of these processes and phenomena are largely related to the name of A. V. Rzhanov and groups of colleagues at the Institute of Semiconductor Physics, Siberian Department, USSR Academy of Sciences. Its core, consisting of I. Z. Neizvestnyy, S. B. Pokrovskaya, A. S. Smirnov and others, was formulated at the well-known FIAN [Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences].

"When Rzhanov began his cycle of investigations, now classical, on thin layers and films," recalls Ye. Cherepov, "the semiconductor seemed to be a house without a roof. You finish the crystal lattice but what do you put over it?"

The Institute of Semiconductor Physics has now become known worldwide in investigations in this field. The special properties of semiconductors, discovered and studied by its colleagues, are the basis of many fourth-generation computer devices and systems. A. V. Rzhanov, even before he defended his doctoral dissertation, was elected a corresponding member of the USSR Academy of Sciences in 1962 for these investigations.

Scientists have now learned how to place tens of thousands of transistors on a small square of a chip, several millimeters on a side. I looked at one such circuit under a strong microscope—it was like looking at a city of many millions from an enormous height.

But scientists continue to compete excitedly in miniaturization of integrated circuit components. The smaller the component in a chip, the faster the

signal travels and this means the faster the speed of the computer increases. The struggle is ongoing for tenths and even hundredths of a micron. One of the main directions is improvement of technology. Methods of producing thin layers are being developed. I was shown in one of the laboratories how, by bombarding a silicon plate in a vacuum with impurities counted in ions, a thickness of layers with other properties of tenths of a micron is being achieved. And this is now universal.

An electron beam draws the pattern of the integrated circuit on the chip. A computer calculates the optimal arrangement of the components, since man is incapable of doing this. According to the predictions of scientists, the level of integration will be increased tens of times in future high-speed very large-scale integrated circuits. The dimensions of the components of these circuits can be compared to some bacteria and DNA molecules.

Although specialists of different countries still hope to cram several million components into a micromodule, there is still a limit to miniaturization. Of course, methods of processing chips will be improved. Let us say that specialists of the Department of Radiation Physics, IFP SO AN SSSR [Institute of Physical Problems, Siberian Department, USSR Academy of Sciences], develop an approach which would make it possible to create three-dimensional circuits on a chip. This in principle promises a solid increase of its capacity. But what happens then?

"Obviously, new physical phenomena will appear," reminisces Yevgeniy Ivanovich. "We will perhaps return to biological structures."

Nature is still an inaccessible model of miniaturization by its system of transfer of genetic information. According to some calculations, the total mass of DNA molecules that carry hereditary information comprises only 3 milligrams among all the people on the planet!

New discoveries will not force scientists to stop, but on the contrary, will constantly stimulate their search.

6521
CSO: 1863/370

18

A HOME COMPUTER

Moscow TRUD in Russian 19 June p 3

[Article by K. Khachaturov under the rubric, "Masters of Their Trade."]

[Text] Capital radio amateurs have created a unique microcomputer designed for home use.

I am very ashamed. Yesterday, I lost to a little metallic box. On the fifteenth move, a device called "Alfa-85" (this was its "year of birth") checkmated me. Even then, as one of its creators, Engineer Stanislav Golubev, maintains, the apparatus was not playing at full power.

Besides chess, this computer for individual use knows another hundred (!) games. On the screen of a colored television, it draws labyrinths, automobile routes, soccer fields, and basketball courts, offering you the opportunity to test your own responses, alertness, and ability to find a way out of a difficult position.

But the main reason for creating the "Alfa-85" apparatus was not entertainment. Its basic purpose is to teach pupils and students the basics of programming and computer technology. It "knows" five basic machine languages and, after working with this computer for not too long a time, you will be able to rub shoulders with practically any computer.

Engineer Vitaliy Bolochev and Radio Assembler Nikolay Danilov worked on the apparatus together with Golubev. All three are short-wave radio amateurs and masters of radio construction. Industrial representatives have become interested in their apparatus.

9645
CSO: 1863/367

SOFTWARE

VIRTUAL MEMORY DEVELOPED TO INTERFACE PERSONAL AND MAIN COMPUTERS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA, 12 July 85 p 2

PATYKO, D.

[Excerpt] Scientists of the Minsk Scientific Research Institute of Computers
have taught computer technology how to use its memory 'intelligently.' A
method of organizing an information bank which is called virtual memory has
made it possible to increase the efficiency of computers many times.

With the new system, a computer operates independently and 'consults' its
external storage as necessary, even without a special instruction of a program.

This innovation, which was first used by the institute's computer center, has
made it possible to increase the number of operators working with a computer
by several times. These operators now perform completely different jobs simul-
taneously without interfering with each other's work. Scientists believe
that in the near future, the virtual memory of main computers will permit full
utilization of small personal computers, with which the work places of
scientists and engineers will be equipped and which will be connected to the
main computers.

This development has already been turned over to organizations which introduce
computer software.

FTD/SNAP
CSO: 1863/409

LIBRARY COMPUTERIZES ARCHIVE ON COMPUTER PROGRAMS

Moscow IZVESTIYA 7 July 85 p 6

KORNEYEV, V.

[Excerpt] Retrieval of information on needed literature pertaining to computer programs and the formulation of algorithms has been speeded up by several times at the USSR State Scientific-Technical Public Library. This is a result of the introduction of an electronic catalog here.

In recent years, the staff of this library, which is the country's largest, has formed a specialized archieve of literature on computer programs and the formulation of algorithms. These publications are in great demand.

"An automated system based on a YES-1060 computer has been developed," said V. Rostovtsev, the library's deputy director in charge of scientific work. "This system permits not only routine information retrieval but also the solution of problems that are new in principle. It has become possible to automate the publication of a monthly index, 'Algorithms and Programs', on the basis of information stored in the computer's memory, for example. It has also become possible to send tape recordings of this index to organizations that have computers of their own. Information obtained from us can be entered by these organizations into their own data banks in ready-to-use form, without extra efforts."

UDC 681.327.22

IMAGE PROCESSING SYSTEM BASED ON ELEKTRONIKA-60 MICROCOMPUTER

Kiev MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 2, Apr-Jun 85 (manuscript received 26 Nov 84) pp 46-48

[Article by enginer A. M. Bakshayev, engineer V. V. Shakh and Candidate of Technical Sciences V. K. Shmidt]

[Text] The problem of developing image processing systems (SOI) based on microcomputers is contradictory in its postulation, since enormous computer resources are required for realization of matrix operations on large-dimension fields in order to achieve results within an acceptable time, determined by the interactive operating mode [1]. However, strict orientation of image processing systems toward a specific class of image conversions limits the composition of the operations to be executed in each of them, determines the specific structure of the data and makes it necessary to develop special hardware and software that has considerable advantages compared to the universal devices of increased performance which are used [2, 3].

The problem of sharing general- and special-purpose computer resources by providing orthogonal access of image frames to the memory and the capability of parallel execution of processes, accomplished by microcomputers, special processors and image processors, has been solved in the system under consideration.
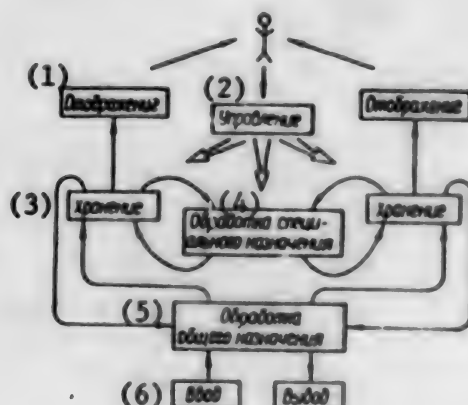

Figure 1. Block Diagram of Image Processing System

[Key on following page]

[Key continued from preceding page]:

1. Display	5. General-purpose processing
2. Control	6. Input
3. Storage	7. Output
4. Special-purpose processing	

The functional structure of the image processing system is presented in Figure 1. The characteristic feature of the given system is the use of two storage operators and two display operators, due to which the following are possible in the image processing system: operating with stereo pairs of images, simultaneous display of which is necessary with any method of image separation, comparison of the initial image and that received as a result of processing, objective evaluation of which can be given only with simultaneous observation of them, simultaneous access to both image fields with independent address spaces, necessary in special-purpose processing.

According to the block diagram, the storage operators are symmetrically connected to the general- and special-purpose processing operators and also to the display operators.

The general-purpose processing operator includes a complete set of functions of the universal microcomputer, which makes it possible to use high-level languages and any point conversions of images, execution of which is achieved within a time acceptable for the interactive mode. Moreover, communications with the image input and output operators is achieved through the general-purpose operator.

Special-purpose processing consists of more labor-consuming spatial filtration operations, determination of spectra, correlation analysis and so on, in which the neighborhoods of each point of space participate. It is this group of operations with specific algorithms for execution of them that determines the main designation of image processing systems, the class of objects to be investigated and the capability of online processing.

The display operator visualizes black-white or pseudocolor images and also provides the capability of observing stereo images.

The control operator provides human interaction with the system in the interactive mode and execution of all control functions.

The physical structure of the image processing system is presented in Figure 2 Its distinguishing features are:

the use of three interfaces--a standard microcomputer interface for program exchange, the Q-BUS, a high-speed exchange interface between the image main memory and special processors, the M-BUS, and a display interface with high-speed television channel, the X-BUS;

hardware realization of the most widespread operations on images--scaling and shift--in the memory controller;

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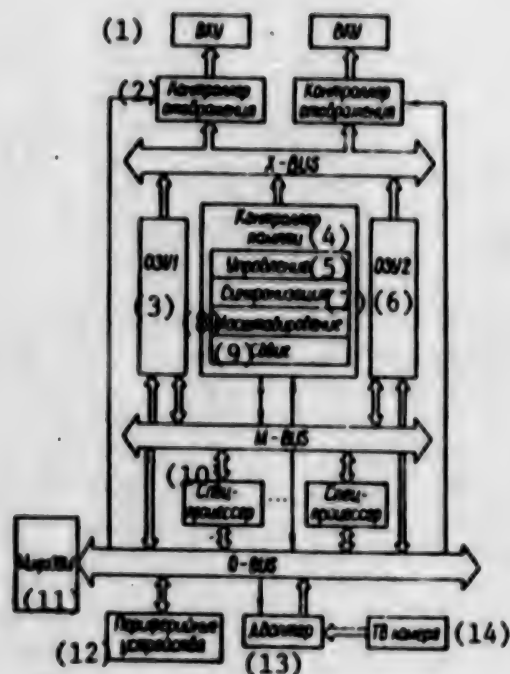
Figure 2. Physical Structure of Image Processing System

Key:

1.	Video monitor	8.	Scaling
2.	Display controller	9.	Shift
3.	Main memory 1	10.	Special processor
4.	Memory controller	11.	Microcomputer
5.	Control	12.	Peripherals
6.	Main memory 2	13.	Adapter

the capability of increasing the number of special processors to be used, modification of them and replacement without disruption of general-purpose hardware and software;

the capability of using the image main memory as the common memory of the microcomputer, which considerably expands its address space and also the word length if necessary.

The main elements of the system are: an Elektronika-60 microcomputer that executes the functions of the general-purpose processing operator and control operator, two image main memory units that execute the functions of data display storage, display controllers and memories for display and access to images during program and special processor exchange, video controllers BHУ for fixing the images, a set of special processors that execute the functions of the special-purpose processing operator, an adapter for communications with a television (TV) camera and also standard systems units--an alphanumeric display IZOT 5400 disk unit and GMD-70 floppy disk, DZM-180 alphanumeric printer and adapter for serial communications with the local computer network.

The initial image is entered by the TV camera or directly from the magnetic storage unit, while the auxiliary graphic image is entered from the keyboard

of the systems display or is shaped by program and is stored in the additional bits of the image main memory. The different graphic data overlay modes (layers of graphics) on the images are achieved by the display controller.

Stereo images are observed by using a color video monitor and anaglyphic glasses. The two images of a stereo pair of photographs are fed to the color video monitor and are displayed in red and blue color.

The memory controller provides independent cyclic shifts and variation of the display scales of both image main memories, which do not affect the program and special processor exchange.

The M-BUS for communications with the special processors is the highest speed unit and has the highest priority compared to the program exchange Q-BUS.

The image main memory is based on dynamic memory elements that require regeneration, which has the highest priority and is achieved within specific moments of time, corresponding to the return path of the line scanning beam of the video monitor. Program exchange and image display are executed independently. The priority of the display process and of the special processor exchange is controlled by the user, which permits one to increase the speed of special-purpose processing at the expense of visualization quality during operation of the special processors.

The set of special processors depends on the three-dimensional processing algorithms, the time of realizing the algorithm and can be expanded at the user's option. The basic version of the image processing system is designed for use of spatial image filtration special processors with arbitrary coefficients at window size of not more than 16 X 16 elements and identification of the corresponding points on the stereo pair of photographs with arbitrary search window.

Processing by spatial filtration (by convolution), algorithms for identification of the corresponding points and a number of other algorithms for spatial processing of signals require information files, consisting of adjacent points of the neighborhood. These features have been taken into account in realization of the M-BUS. The special processor changes the coordinates of the image point and reads or writes the point brightness code by using special commands transmitted through the M-BUS. The system of special processor exchange commands is represented in Figure 3. The coordinates of the initial point of the file (X_0, Y_0) are controlled by program through the Q-BUS; the moving coordinates with unit increments through coordinates X and Y (commands $X := \pm 1$; $Y := \pm 1$) and the return commands to the initial horizontal (the command $Y := Y_0$) or vertical (command $X := X_0$) are formulated through the M-BUS. The image memory automatically converts to the read mode after any command to change the coordinates. Information is written to the memory by the command ЗАПИСЬ.

The image memory is designed on the principle of separation of access to the memory, consisting of 16 groups, which permits parallel reading of 16 adjacent points and the necessary image regeneration mode on the screen of the video monitor. Because of this, the time required to read a sequence of image

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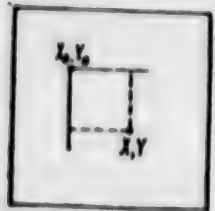
Figure 3. Addressing Points of Image Frame Upon Exchange Through
M-BUS

points depends on whether the moving coordinates change within the limits of a
single group of points or whether they are related to different groups. Thus,
a rapid line-by-line circuit of a square image raster is made, which is the
necessary element of spatial processing of signals.

The specifications of the image procesing system provide:

image input from a television camera with 512 X 512 pixels and 256
brightness levels;

storage of two images measuring 512 X 512 points in eight bits per
point;

the presence of three auxiliary layers of graphics in each image memory;

visualization of images on a standard black-white video monitor with
512 X 512 pixels and 64 brightness levels;

visualization of images on a standard color video monitor with 512 X 512
pixels and 16 brightness levels for each main color, the possibility of
display in pseudocolors and observation of stereo images (storage of a color
image with 256 brightness levels can be provided with connection of a third
image memory);

read time of an image point through the M-BUS of 0.3-0.24 µs;

write time of an image point through the M-BUS of 0.8-2.4 µs;

maximum command tracking frequency through M-BUS for changing moving
coordinates of image point of 10 MHz;

time of executing spatial filtration by 16 X 16 element window using a
special processor of 30 seconds.

The principles of structural organization of the image processing system pro-
vided the capability of effective use of it in investigation and development
of stereo image and spatial signal processing methods. Clearer boundaries of
the areas of feasible use of general- and special-purpose operators were
determined during operation of the system, which is the key question in design
of the given class of image processing systems.

Improvement of the structure of the image processing system is subsequently possible in the direction of increasing the number and of expanding the functions of the storage operators and of using tabular methods of computation in the special-purpose processing circuit.

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ABOUT MACHINE TOOLS WITH NUMERICAL PROGRAM CONTROL AND ABOUT FASHION: NOTES
FROM A MEETING OF THE UKRAINIAN SSR COMMITTEE ON PEOPLE'S CONTROL

Kiev PRAVDA UKRAINY in Russian 29 May p 2

[Article by K. Bychek, section chief, and V. Kovalchuk, section inspector,
UkSSR Committee of People's Control.]

[Text] Such concepts as "manipulator," "robot technology," "program control,"
and so forth, are becoming more and more usual to our ears. And this is not
surprising.   Scientific and technical progress is heavily intruding into all
spheres of activity. And first of all into manufacturing. And from each
innovation, society has a right to expect an appropriate economic effect,
the return for which it was created. But is it so, everywhere?

The committee has investigated how metal-cutting machine tools with numerical
program control and automatic manipulators are used at chemical and petroleum
machine-building enterprises located in the republic. For the sake of fair-
ness, it should be noted that certain work is being conducted on introducing
means for mechanization and automation. During recent years, several hundred
of such machine tools and automatic manipulators have been put into operation.
To make better use of them, at a number of enterprises, specialized sections
have been organized and special-purpose technical services have been created.

But managers of some enterprises, having ordered so much costly equipment
(sometimes, apparently, just following fashion), then lose interest in it and
do not provide for its effective use.

The reasons for such loss of interest are various. Often, they order machine
tools, but the industrial premises are not ready for them. There are cases
where they make a request for equipment but do not concern themselves properly
with the work load. As a result, it stands idle for years. For example, as
far back as 1980, the Ivano-Frankovsk equipment plant received a lathe-
carousel machine tool that cost tens of thousands of rubles, but it came to
life only after three and a half years.. Two vertical drill presses have lain
here as dead weight since 1983. Incidentally, the Konotop equipment plant
acquired the same kind of machine tool almost four years ago and immediately
included it on the list . . . of superfluous equipment. Is not such pursuit of
fashion too costly to manage?

And here is a picture on another plane. Plainly, a machine tool with numerical program control is not a sledge hammer. The technology is subtle and complicated and requires an attitude that corresponds to it. But what really happens sometimes? At the Berdyansk "Yuzhgidromash" plant such machine tools were placed in many production shops without any technical or economic substantiation. In this case, they were not concerned about observing certification requirements: on the stability of the electric power supply, dust, moisture, and air temperature drops. The new technology reacted accordingly: last year, the down times of machine tools with numerical program control constituted half of full-shift down times. Machine tools of the same kind at the Svessa pump plant (Sumy Oblast) were idle almost a sixth of the total available time. And again, the reason was the same as with the Berdyansk people--an incorrect attitude.

It is true that, at the Svessa plant, measures also were not taken for the timely resolution of other problems. This means, first of all, the training of operators, electronic specialists, and programmer-technologists. Machines are intelligent but, without specialists, they will not run. And it naturally results that, because of the lack of training of operators, the manufacturing center stood idle almost a third of the time allotted to it for work.

Such neglect also takes place in the "Melitopolkholodmash" association at the Ivano-Frankovsk equipment plant, where there are only three programmer-technologists to service over a score of machine tools with numerical program control.

Lack of programs, in turn, leads to a situation where highly productive and sophisticated machines are turned into ordinary machine tools, and they are used to do the most simple operations. At the Bakhmach chemical machine-building plant, for example, a lathe with numerical program control does . . . stripping of stock. More than ten such machine tools at the Konotop equipment plant are used to finish components with a 3 to 5 minute cycle. Clearly, under such a regime, multi-machine-tool maintenance will not be carried out.

One should also point out that many machine tools with numerical program control are switched over to work in a manual regime. In short, it is like the man who, pitying the horse, pulls the wagon himself.

It would seem that expensive, highly productive equipment should be the object of special attention on the part of enterprise managers and specialists. But no. At many enterprises--specifically at "Melitopolkholodmash," "Yuzhgidromash," and at the Fastov "Krasnyy Obtyabr" plant--analysis is not being done on the reasons for down time, and there is no concern about increasing the work load.. For this reason, five machine tools at the Bakhmach plant on 26 March were idle, even during the first shift.

At some enterprises, heavy ordeals fell to the lot of machining centers and robot technology. Thus, at the "Zaporozhpromarmatura" plant, of six industrial robots, only three are operating. The same number of automatic manipulators at the Svessa pump plant can in no way be taken out of the experimental stage.

Naturally, these shortcomings in the efficient use of new progressive equipment have led to a situation where the majority of plants are not meeting their established work-load goals. In a number of instances, this gap is impressive. It is also surprising that, for some enterprises--for example, the "Melitopolkholodmash" association, the Berdichev "Progress" plant, the Konotop equipment plant, and the Fastov "Krasnyy Oktyabr" plant--where there are many machine tools with numerical program control, work-load indices have not been planned for at all.

Also, one cannot avoid the question of organizing the technical maintenance and repair of this equipment. These are poorly supplied. Plants are extremely unsatisfactorily supplied with spare parts, tools, diagnostic devices, and organizational techniques for program preparation. All-union industrial associations have not given the necessary aid in the solution of these problems.

There was stern talk during the examination of the results of the investigation. The committee demanded that the following take urgent measures to eliminate the exposed shortcomings in the use of machine tools with numerical program control and in the use of robot technology: the general director of the "Melitopolkholodmash" association, D. I. Grishchenko; the director of the Ivano-Frankovsk equipment plant, A. F. Gontarzh; and the director of the Bakhmach chemical machine-building plant, I. Ye. Suslin. The committee reprimanded the chief engineers of these enterprises: A. I. Shevchenko, A. M. Sidoruk, and I. A. Oleshchenko.

Local committees of people's control were authorized to examine the question as to the responsibility of officials of other plants covered in the investigation.

The committee sent notes on the results of the investigation to the USSR Ministry of Chemical and Petroleum Machine Building.

9645
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SOME FEATURES OF THE PROCESSING OF UNRECOGNIZED WORDS IN MACHINE TRANSLATION SYSTEM

KOROSTELEV, L. YU.

[Abstract] A procedure is described for handling the problem of unrecognized words in machine translation. A system is described that diagnoses and corrects distortions in input text words that have not been recognized in the dictionary look-up stage.   The method employs stochastic polygram trees that are generated automatically from correct words. The algorithm embeds the polygrams of an unrecognized word in a tree of correct polygrams, and corruptions are corrected by generating the most probable replacement for the corrupted part of the word. The method is economical, in that the number of polygrams is smaller than the number of words from which they are derived; the method also indicates the location of a distortion to within a character. In addition, the method is also able to predict undistorted "unfamiliar" words. An example of the use of the algorithm with a French input text is presented. Figures 2, references 16: 14 Russian, 2 Western.
[369-6900]

LIBRARY AUTOMATION AT INTERNATIONAL CENTER OF SCIENTIFIC AND TECHNICAL INFORMATION

Moscow SOVETSKAYA ROSSIYA in Russian 21 Jun 85 p 4

[Article by V. Kashitsin: "The Electronic Library"]

[Text] The opinion is widespread that scientists are overwhelmed by the information flow. Indeed, thousands of books, articles and conference proceedings on different fields of knowledge are published annually. Much time must be wasted to find the necessary information in this flow.

Having visited the International Center of Scientific and Technical Information, I was convinced that this problem has been completely resolved. Abstracts of dissertations and scientific reports of the institutes of CEMA countries over the past few years in all fields of science, written on computer storage devices, have been assembled in one of the repositories of the center, in a small room blocked with metal cabinets! True, they can be "read" only by using a computer.

It is sufficient to ask several questions of the information retrieval system and within several seconds a list of the published papers on a specific topic and brief annotations of them appear on the display screen. One additional command and a copy of the required article is printed on a special device. And what happens if many viewers desire much information?

"In this case the displays at the workstations of scientific colleagues must be connected to a computer system and a so-called local computer network must be created," relates the scientific associate of MTsNTI [International Center of Scientific and Technical Information] K. Vinogradov. "We now utilize the Estafeta local computer network, developed at the State Planning and Design Institute for Automated Control Systems (GPKI ASU) at Ivanovo. It makes possible joining up to 125 different devices in a ring: computers, displays and automated workstations. Using ordinary telephone lines, displays and small and large computers, one can communicate at a distance of more than a kilometer.

Estafeta is one of the first local computer networks with a broad range of capabilities, developed by Soviet specialists. It is planned to develop systems for automation of institutional activity, to use it in flexible production systems and of course to use it in multiuser information retrieval systems.

An integrated experiment on access to databases using satellite communication lines between scientific research centers for information processing of the USSR and other CEMA countries is now being completed at MTsNTI.

These information bridges have already connected Moscow and Ulan Bator, Hanoi and Havana. Problems of the interaction of local computer networks with global networks are being solved within the framework of this experiment.

6521
CSO: 1863/370

PROBLEMS OF AND PROSPECTS FOR DEVELOPMENT OF AUTOMATED CONTROL SYSTEMS

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian No 3, May-Jun 85 pp 542-556

[Report of roundtable conference, organized by EKONOMIKA I MATEMATICHESKIYE METODY, scientific council, USSR Academy of Sciences, on complex problem of optimal planning and management of national economy, scientific council, USSR State Committee for Science and Technology, on problem of using optimization problems in automated control systems, Izdatelstvo "Nauka"]

[Text] A "roundtable" conference, organized by EKONOMIKA I MATEMATICHESKIYE METODY, the scientific council on the complex problem "Optimal planning and management of the national economy," USSR Academy of Sciences and by the scientific council on the problem of using optimization methods in automated control systems, USSR State Committee for Science and Technology, devoted to timely problems of developing automated control systems, was held on 5-6 December 1984.

The materials of the discussion are published in abbreviated form.

Academician N. P. Fedorenko. Investigations have been conducted for more than 20 years in our country on creation and development of ASU [automated control system]. The approximate mid-point of this path was noted by a roundtable meeting on problems of automated control systems, held by the journal in 1974.* Specialists then summarized the preceding period and generalized the accumulated experience.

This is why we decided to hold a roundtable meeting on the problems of and prospects for development of automated control systems. A preliminary list of the problems (there were 14 of them) was prepared and was distributed together with invitations to participate in our discussion to prominent specialists working on different aspects of this problem—theoreticians and practitioners, designers and operators, developers and users, managers and representatives of the higher schools. Our goal was to concentrate attention on the most acute and most important theoretical and applied problems for further development of automated control systems. We attempted in this case to follow the instructions of the CPSU Central Committee, which noted in its decree "On elevating

* See EKONOMIKA I MATEMATICHESKIYE METODY, No 6, 1974; No 1, 1975.

the role of the Institute of Economics, USSR Academy of Sciences, in working out key problems of the economic theory of developed socialism": "Important significance is being given to systematic and purposeful scientific discussions, bringing them to results that enrich science and that make it possible to work out recommendations for practice" [KOMMUNIST, No 4, 1984, p 16].

The detailed written answers of 39 specialists were given to our "questionnaire." They included B. A. Avrov, chief of the planning and economic administration, Minradioprom SSSR [USSR Ministry of the Radio Industry], Doctor of Economic Sciences V. B. Bezrukov, chief of GVTs [Main Computer Center], USSR Gosplan, Doctor of Economic Sciences N. G. Belov, deputy chief of USSR TsSU [Central Statistical Administration], Candidate of Economic Sciences B. Yu. Blazhis, deputy director of IE AN LitSSR [Institute of Economics, Lithuanian SSR Academy of Sciences], Candidate of Economic Sciences A. M. Vaynzov, laboratory head of VNITI [All-Union Scientific Research and Design-Production Institute of the Pipe Industry], USSR Minchermet [USSR Ministry of Ferrous Metallurgy] (Dnepropetrovsk), Doctor of Economic Sciences A. A. Vasilyauskas, director of NIIBP [Scientific Research Institute of Economics and Planning] attached to Lithuanian SSR Gosplan, Candidate of Economic Sciences B. A. Volchkov, director of Scientific Research Institute of Automated Control Systems attached to RSFSR Gosplan, Candidate of Technical Sciences L. V. Gigineyshvili, director of Georgian Branch of VNIIPOU [All-Union Scientific Research Institute on Problems of Management Organization], USSR State Committee for Science and Technology, Candidate of Economic Sciences K. P. Glushchenko, laboratory head, Scientific Research Institute of Systems, USSR Minpribor [USSR Ministry of Instrument Building, Automation Equipment and Control Systems] (Novosibirsk), Candidate of Technical Sciences O. V. Golovanov, Director of VNIPI OASU [All-Union Scientific Research and Design Institute for Sector Automated Control System, USSR Minpribor, Candidate of Technical Sciences L. G. Golub, department head, Scientific Research Institute of Construction, Estonian SSR Gosstroy, Doctor of Economic Sciences V. V. Yevdokimov, deputy general director of NPO [Scientific Production Association] Lenelektronmash, Academician L. V. Kantorovich, scientific director of VNIISI [All-Union Scientific Research Institute of Sanitary Testing], USSR State Committee for Science and Technology and USSR Academy of Sciences, Doctor of Economic Sciences D. Kh. Karimov, deputy chairman of Tajik SSR Gosplan, Doctor of Economic Sciences B. I. Kruglikov, deputy head of GlavNIIVTs [Main Administration of Scientific Research Institute of Computer Center], Ukrainian SSR Gosplan, Candidate of Economic Sciences R. Ya. Levita, department head, GIVTs [Main Information Computer Center], USSR Mintyazhmash [USSR Ministry of Heavy and Transport Machine Building], Doctor of Technical Sciences A. G. Mamikonov, laboratory head of IPU [Institute for Control Problems], corresponding member V. L. Makarov, director of VNIIPOU GKNT SSSR, Doctor of Economic Sciences M. T. Matveyev, director of GlavNIIVTs, Ukrainian SSR Gosplan, Doctor of Technical Sciences N. B. Mironosetskiy, deputy director of IE OPP SO AN SSSR [Institute for the Economics and Organization of Industrial Production, Siberian Department, USSR Academy of Sciences], Doctor of Technical Sciences S. B. Mikhalev, director of TsNIITU [Central Scientific Research and Planning Production Institute of Management Organization and Control Equipment], USSR Minpribor (Minsk), Candidate of Economic Sciences G. V. Oboladze, director of Main Information Computer Center, USSR Mintyazhmash, Doctor of

Physicomathematical Sciences A. A. Pervozvanskiy, Professor of Leningrad Poly-
technical Institute imeni M. I. Kalinin, Candidate of Economic Sciences Yu. N.
Perevalov, Scientific Administration for Organization of Production, AvtoVAZ
[Volga Automotive Works imeni 50-letiya SSSR], Candidate of Economic Sciences
S. Ye. Petrova, chief of OASUP [ASUP department], MPO [Interdepartmen-
tal Association] Second Watch Plant, Candidate of Economic Sciences B. V.
Prilepskiy, director of Berd Chemical Plant, Candidate of Economic Sciences
B. S. Podkopayev, director of Barnaul Radio Plant, Doctor of Economic Sciences
V. M. Portugal, head of department, Odessa Polytechnical Institute, Candidate
of Economic Sciences A. S. Redkin, prorector, Odessa Institute of the National
Economy, Candidate of Economic Sciences Kh. O. Repp, department head, Moscow
Cooperative Institute, Doctor of Economic Sciences F. I. Rudnik, chief econo-
mists of Frezer Plant, Doctor of Technical Sciences V. S. Sinyak, department
head, Academy of the National Economy attached to the USSR Council of Minis-
ters, Candidate of Economic Sciences G. M. Sokolov, manager of Moscow Munici-
pal Office of USSR Stroybank, Candidate of Technical Sciences B. Ye. Trenchuk,
director of NPO Kislorodmash, Candidate of Technical Sciences Yu. I. Tychkov,
Candidate of Technical Sciences B. I. Fomin, general director of Leningrad
Electrical and Machine Building Production Association Elektrosila, director
of economic sciences Yu. A. Chernyak, laboratory head, VNIPI [All-Union
Scientific Research and Planning Institute of Economics and Control Systems],
USSR Minvodkhoz [Ministry of Reclamation and Water Management], Doctor of
Technical Sciences Yu. M. Cherkasov, general director of NPO Moskva ASU,
Mosgorispolkom, and Candidate of Economic Sciences L. Z. Sheynis, department
head, ASUrybproyekt, USSR Minrybkhoz [USSR Ministry of Fisheries].

The answers to the questions comprised rather extensive m, erial. Therefore,
we decided to present survey reports for your attention, in which the most
significant of the answers is reflected in compressed, generalized and system-
atized form. They convincingly demonstrate how thorough is the understanding
of the problems that we face in providing a planning and management system for
the national economy (and for its individual sections) through means of auto-
mation and through modern technical and methodological instrumentation of the
decision-making processes. Practical experience has taught all of us much in
introduction and development of automated control systems. The most important
proposition is that automated control systems should be oriented toward a
realistically operating system rather than toward abstract schemas, since the
processes of improving the organizational structures of management and of the
entire economic mechanism, on the one hand, and of equipping management activ-
ity with hardware, information systems, economic-mathematical models and so
on, on the other hand, do no simply proceed simultaneously, but should be
synchronized and coordinated; moreover, priority undoubtedly belongs to the
first aspect--to the significant problems of improving the national economy.
Only if this condition is observed will automated control systems meet the
requirements of practice and will they achieve the goal, for which they are
developed and for which they are actively effective.

However, in making correct conclusions from analysis of accumulated experi-
ence, we still have an insufficiently clear concept of the contours of future
development of automated control systems, in any case if one bears in mind
long- or at least medium-term problems rather than short-term problems. It is

felt that it is time for us to closely set about strategic developments in this field with regard to the inevitable radical transformations in computer and organizational technology.

I will touch separately the state of affairs in optimization calculations. It is known that a pessimistic view on the possibilities of practical use of available instrumentation has gradually come to be manifested over time due to a number of unsuccessful attempts to apply the model approach to solution of planning problems. But in those cases when developers have manifested persistence and an understanding of the real conditions of management and do not shirk the subjective and objective difficulties, forward movement is quite obvious. Let us take for an example the area where it is generally recognized that introduction of optimization calculations has not achieved the proper development--current sector planning. It is here that the problems of combining methods of optimization with the effect of the real economic mechanism are most acute. It is here that planning is directly related to implementation of the plan and to functioning of production objects. It is here that the advantages and disadvantages of the optimization approach are clearly obvious in daily, operational calculations.

Representatives of the ministries of fisheries and ferrous metallurgy were present at our conference. They of course shared their own experience in solving problems of optimization of present plans, which has been instructive in many respects. I would like to turn your attention toward its positive aspect. A complex of interrelated optimization problems for different levels of the management system is being exploited at the USSR Ministry of Fisheries: from the scheduled voyages for ships of the fishing industry fleet and plans for shore fish processing enterprises to compilation of the plan for the ministry as a whole. Exploitation of these problems has been firmly included in planning and management of the sector for the last 8 years. If one talks about the economic effectiveness of the complex of optimization problems of the USSR Ministry of Fisheries, I would like to note yet another no less convincing fact of their effectiveness, besides the traditionally calculated millions of rubles of saving. In 1976, the 200-mile economic zone, forbidden to other countries, was announced by practically all governments engaged in fishing. However, the catch of ocean fish decreased by only several percent under these most complicated conditions for the USSR Ministry of Fisheries and has now been restored to the level of the most productive years. According to admission of the sector management, optimization calculations played an important role in mobilization of reserves of fish- and product-output plans.

There is experience at the USSR Ministry of Ferrous Metallurgy in solving the problems of present planning, which are intersector in nature and therefore are even more difficult to implement. And, indeed, practical introduction of the results was achieved here through enormous efforts. It would seem that the fact of a significant saving is evident: the possibility of increasing product output, of eliminating the shortage of pipe of specific diameter and of a significant reduction of the average radius of shipments are provided. The management of USSR Gossnab and USSR Ministry of Ferrous Metallurgy are receiving the results with great interest. Nevertheless, the system of calculations should open a path through many obstacles of the most complicated technology and organization of planning.

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It is easiest under these conditions to sit on one's hands and to perceive an automated control system only as an automated information system. However, regardless of how timely and effective automated information systems are they are only the "ground" floor of automated control systems.

True, the time for excessively optimistic hopes and forecasts is past. The number and complexity of problems related to functioning and development of automated control systems are increasing continuously and, apparently, not because operating experience has permitted us to determine these problems. This is a comforting fact, since correct formulation of a problem means to make an important step toward solving it. One of the main tasks of our round-table meeting is to determine the current problems of developing investiga-tions in automated control systems. Another important task is to determine the views of the participants toward methods of solving these problems.

I would again like to repeat in conclusion the introductory words that I began the debate begun by the journal 10 years ago: "A roundtable should symbolize the total equality of the participants, the absence of any preconceived ten-dency and attempts to press any opinion or to confirm any document." We are grateful to those who responded to the journal's appeal to participate in the discussion, which we begin today. I hope that, despite the different and sometimes diametrically opposite positions, we will be able to maintain a spirit of mutual understanding.

The members of the editorial board of the journal appeared at the meeting with surveys of the answers to questions: Doctor of Economic Sciences V. I. Danilov-Danilyan (laboratory head of the Academy of the National Economy attached to the USSR Council of Ministers), Doctor of Economic Sciences Ye. Z. Mayminas (professor at Moscow State University, laboratory head of TsEMI [Central Economic Mathematical Institute, USSR Academy of Sciences]) and also Candidate of Economic Sciences V. I. Danilin (laboratory head of TsEMI).*

1. Has the concept of development of automated control systems changed since the time our journal held the roundtable on automated control systems? Does this concept correspond to the problems of today and to future development of the national economy?

The answer to this question primarily assumes a refinement, what is meant by the concept of developing an automated control system during the period when the first roundtable meeting was held? Even then, many participants talked about the absence of a unified concept and no so much due to disagreement of the viewpoint toward the problem as because of its insufficient development.

During the past 10 years, on the one hand, the front of applied investigations was expanded sharply and, on the other hand, investigations of individual, relatively special aspects were intensified and made more extensive. With regard to theoretical generalizations and comprehension of the problem as a whole, then perhaps no appreciable events have occurred here.

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* The surveys are grouped by questions; formulation of the questions are in italics.

Hardly half of the 39 specialists who sent answers touched on the question of the concept of developing an automated control system and there were few detailed answers, but everyone notes the exceptional importance of this problem. Thus,Yu. I. Tychkov feels: "the problem of formulating a general concept, on the basis of which investigations in improvement of control should be carried out by industrial enterprises is even more timely." B. I. Fomin talks about the same thing, but more specifically: "Development of automated control system at the given phase is often cluster and nonindustrial in nature. Most enterprises are forced independently, by trial and error methods, to find organizational and technical solutions in development of a man-machine control system. The managers of enterprises (associations) need a unified program of investigations to develop a man-machine control system." V. B. Bezrukov, M. T. Matveyev, Yu. M. Cherkasov and others also talk about the timeliness of developing a unified concept of an automated control system.

However, one should note that some participants proceed from the basis that there is a concept of developing an automated control system. Thus, B. Ye. Trinchuk assumes that as a whole, "the concept has not changed and corresponds to today's and future requirements" since the time of the first roundtable meeting. V. L. Makarov expresses a similar opinion: "With regard to the principal questions of the concept of developing an automated control system, they have not changed significantly, but bottlenecks in the practice of developing automated control systems of different level and designation have only been denoted more sharply." The fixed nature of the concept over the past 10 years, but with negative evaluation of this circumstance, is emphasized by S. Ye. Petrova and Yu. M. Cherkasov, who notes that "the officially announced part of the concept of developing an automated control system has not changed in the past. This concept has become further consolidated in a number of management and methodical materials of statewide and sector level. However, besides the official concept, there is also the real practice of developing automated control systems." Finally, V. V. Yevdokimov thinks that the concept has undergone significant changes and "corresponds fully to the requirements of development of the national economy." In some of the most informative answers to the questionnaire, the dynamics but not the concept, but rather the circumstances more significant for its content (in the economic mechanism, computer technology, methods of operation and so on) are convincingly discussed. Considerable changes in the components as well, which should be included in the concept as its important constituents, are noted.

It is quite valid to compare the concept or, with regard to the foregoing, the combination of concepts with respect to prospects for developing automated control systems during the period of the first roundtable meeting with the modern concepts. If this combination cannot be detected in some normative document or in generalizing scientific work, then it can be determined by parts from publications, speeches (including those at the first roundtable meeting), design experience and experience of introducing specific automated control systems. True, the combination of concepts--a conglomerate rather than a system--may accept individual elements of it and reject the remaining ones, may in practical activity follow the former and pay no attention to the latter. As matters actually developed, a similar pattern is observed even now.

Central in the combination of concepts under discussion was the statement that "the automated control system is an economic management system, growing from an existing system based on equipping it with new scientific methods, modern technology and management techniques."* Deviation from some recommendations, advanced in the theory and formulated in methods, is regularly encountered in practice, usually because of design simplifications or the realizability of a system to be designed or introduced. Yu. M. Cherkasov, noting "the tendency toward review of the concept of the automated control system in a detour from orientation toward solution of management tasks and concentration on data acquisition and processing tasks," evaluates it "as capitulation to occurring difficulties" (however, the mass nature itself of the noted phenomenon indicates that the matter does not validly reduce to "capitulation," but rather we are observing a quite substantiated maneuver). K. P. Glushchenko speaks quite specifically in this regard: "Along with understanding an automated control system as a complete economic object management system (including all the elements existing in a "nonmachine" system), there is also the 'technocratic' management, when the automated control system is identical with an electronic data processing system."

However, most participants of the discussion hold a different view. Suggesting that "we think about the problem of the role and place of an automated control system in the overall process of improving management," O. V. Golovanov notes: "It makes sense to talk about efficient use of computers in control processes. The concept of the automated control system should also be changed in this regard." R. Ya. Levita states that "existing organizational-economic automated management systems should not be called ASU, but ASOU-- automated management servicing systems," and apparently feels that this position is the correct one, since he further notes that "the existing method of evaluating the effectiveness of an automated control system is in total contradiction to its real essence. It proceeds from the concept of total restructuring of managing the national economy on the basis of automation, which was established at the dawn of the 'cybernetic boom'." Yu. I. Chernyak considers the "paradox of today that both the understanding and qualification are insufficient for developing effective automated, the same as nonautomated control systems. The developers of automated control systems, like those who are practically involved in other spheres of management, encounter unresolved problems that go beyond the level of their competence"; obviously, not only are modern (and future) management systems not identical with automated control systems, but the latter are quite clearly distinguished from management as a wnole as one of its spheres.

Specific centralized measures to improve the management system should have the goal of activating internal reserves in all its sections and in each one of them specifically. This means specifically the requirement of orienting the management apparatus toward the workers, primarily of the first managers, since, regardless of how the organizational-economic management systems change, the workers remain in them. This need was stated by many participants, for example, B. A. Avrov, L. V. Gigineyshvili, L. G. Goluboy, D. Kh. Karimov, A. G. Mamikonov, N. B. Mironosetskiy and Yu. M. Cherkasov.

One should also recall the intensified attention toward automated information systems (AIS), which undoubtedly was determined by the real needs of workers in the management sphere. Whereas many participants write approvingly about this, as already noted, K. P. Glushchenko and Yu. M. Cherkasov have a negative attitude. It is felt that everything revolves around work on automated information systems: evaluation of unsuccessful, too "grounded" designs should not be applied to the entire direction; an automated information system is frequently the only one that can now be developed for equipping organizational-economic management systems with computer technology.

Conditions are now being formulated rapidly for integration on a unified technical base of such subsystems as AIS, SAPR [computer-aided design system], ASU TP [automated production process management system] and providing calculations on economic-mathematical models. This most important direction of development in automation of management has been noted by many--B. A. Avrov, A. A. Vasilyauskas, K. P. Glushchenko, V. V. Yevdokimov, B. I. Kruglikov, N. B. Mironosetskiy, Yu. N. Perevalov, S. Ye. Petrova, F. I. Rudnik and other participants of the discussion. Let us emphasize that elements of the same level of management and of the subsystem, directed toward automation of different aspects of management activity within a single object, are integrated here.

Another essential direction of developing automation in management is simplification and facilitation of user interaction with the computer. Promising methods of solving the problems resulting here should affect the formulation of the modern concept of the automated control system. Development of automated workstations (ARM) for managers, planners and supervisors--a question to which B. A. Avrov, A. A. Vasilyauskas, L. V. Gigineyshvili, D. Kh. Karimov and other specialists turn--now acquires special significance.

2. Much was written during the 1960s-1970s about the "psychological barrier" as almost the only obstacle in introduction of ASU. Has the situation now changed?

A. A. Pervozvanskiy correctly noted: "There is essentially no mention of the 'psychological barrier' in the published materials of 1974." Nevertheless, many in fact wrote about the "psychological barrier" at the end of the 1960s and early 1970s, but practically everyone states in their answers to the questions to the given roundtable meeting: the question was perhaps the most popular one. The answers were not only numerous but very diverse in their evaluations and at first glance give the impression of variegation and different levels of planning. However, more careful study of the material demonstrates that the differences are not the principal ones and are explained primarily by the terminological variety and difference of emotional attitude of the authors to the question.

Some participants (K. P. Glushchenko, B. V. Prilepskiy and Yu. I. Tychkov), noting that the situation with the "psychological barrier" has hardly changed during 10 years, have in mind primarily the fact that significant difficulties remained in interaction of the management apparatus with the computer. When B. Yu. Blazhis, O. V. Golovanov, R. Ya. Levita, Yu. I. Chernyak and others write about the fact that the "psychological barrier" has no essential

significance at present, they are not reflecting the difficulties, but are relating them to other factors--social, technical, organizational, the economic mechanism and so on. And whereas B. A. Avrov, B. A. Volchkov and Yu. M. Cherkasov state the occurrence of "new barriers," contradictions do not arise either with the former or the latter viewpoints. In exactly the same way, there is no controversy when V. B. Bezrukov, V. L. Makarov and A. G. Mamikonov and again B. A. Volchkov and K. P. Glushchenko state that the "psychological barrier" has now lost its specifics and is indistinguishable from the factors that determine the difficulties of introducing any innovations, and therefore these difficulties not only existed but will always exist.

The discussion of the "psychological barrier" actually turned into analysis of factors of a social, organizational and economic nature that prevent automation in management or that inhibit it and of the causes that affect these factors. Obviously practically everyone agrees that the "psychological barrier" has now been mainly overcome in the initial, precise and narrow meaning, i.e., a type of "fear" of computers as something competely incomprehensible and "absolute" distrust of the capabilities of automation in management.

The problems of improving the economic mechanism, which are considered by some participants instead of the "psychological barrier" or as a specific factor of it, are further analyzed in discussion of question 6. Let us enumerate here only the other factors which were named as those which make it difficult to introduce automation in management:

reevaluation of the real capabilities of ASU, especially during the first years of their development (L. V. Kantorovich and R. Ya. Levita);

the precedents of unsuccessful introduction of ASU on a background of excessive advertisement (B. A. Volchkov, L. V. Kantorovich and B. V. Prilepskiy);

lack of understanding by developers of the real requirements of the management apparatus (L. G. Golub and Yu. M. Cherkasov);

insufficient interest of the first managers in formulating an "order" for ASU, in its design and in use (L. V. Kantorovich, D. Kh. Karimov and Yu. M. Cherkasov).

Among the measures, essential to overcome both the "psychological barrier" itself (assume that it has even decreased appreciably) and of the other obstacles, many participants (L. V. Gigneyshvili, D. Kh. Karimov, V. L. Makarov, YU. N. Perevalov, S. Ye. Petrova, B. V. Prilepskiy, Kh. O. Repp, F. I. Rudnik, B. Ye. Trinchuk, Yu. I. Tychkov and others) note the need to improve the skills of users, especially training of managers. This aspect is directly related to the third question.

3. What are the real possibilities of using modern ASU in economic management? How has the situation changed during the past 10 years? What are the prospects of these capabilities? What changes in the system of training managers and staff executors are feasible in this regard?

4.   State your views on the process of developing effective management systems under different conditions from the viewpoint of supporting them with means of automation (methodical, hardware, information support and so on).   What are the obstacles in this path and do methods of overcoming them exist?

The third and fourth questions are combined here for three reasons: first, the corresponding aspects are illuminated to a significant degree during survey of the materials on question 1, secondly, the number of specialists who answer these questions in detail is relatively small and third, the questions are rather similar in content.

Discussing the real capabilities of using modern ASU, the participants of the discussion usually dwelt on specific spheres and objects of management (N. G. Belov, A. M. Vaynzof, V. M. Portugal, Kh. O. Repp, F. I. Rudnik, G. M. Sokolov and so on). Among the most important changes that have occurred over 10 years, the development of personal access aids, interactive systems, creation of conditions for online support of managers with needed information and the tendency to integrate organizational-economic management support systems with ASU TP, SAPR and AIS are noted. The complete use of these capabilities is linked primarily to the change in the nature of the relationships of system designers with users. Thus, M. B. Mironosetskiy writes: "We feel that the participation of the primary managers in improving the management systems are exceptionally promising." B. A. Avrov writes in detail: "We feel that 'accustoming oneself' of groups of developer-analysts, capable of revealing the informative aspect of the management 'mechanisms,' of analyzing methods of improving them and of postulating the tasks of analysis, management and decision-raking in ASU into the management apparatus."

Among the most promising aspects of developing existing ASU, the feasibility of intensifying "centralization in information support" (Yu. M. Cherkasov) and of improving the information subsystems themselves (V. L. Makarov and others) is often noted. G. M. Sokolov assumes that "existing ASU strongly lose due to the imperfection of organization of the data acquisition process in them and of transmitting the results to users. Investigations must be developed in every way to create high-speed data transmission systems and networks, to organize automated workstations and to introduce telecommunications methods and interactive modes of communicating with the user."

V. B. Bezrukov states that "the process of developing ASU has clearly slowed down" during the past few years; he notes that the simplest aspects have been developed successfully, "transition to essentially new methods of substantiation and adoption of planning decisions is also being delayed by deficiencies of the existing simulation apparatus and by limited capabilities of existing computer technology, by slow restructuring of the planning method and so on." Similar factors are also named by other participants of the discussion. L. G. Golub fixes an important aspect: "Methodology and the method of introduction, i.e., conversion from traditional methods of management to automated methods, did not become the object of serious scientific investigation. It essentially reduces to problems of determination and elimination of "fine points," which do not satisfy the user in an automated system. Useful optimization problems do not find practical application in some cases because

of them. The lack of desire of developers to satisfy "minor" requirements of users (and determination of these requirements continues for a rather long time, sometimes for years even after formal completion of introduction) leads to gradual refusal to use the models."

Finally, some specialists note the undoubted obstacle in the path of developing existing and of developing new systems as a shortage of equipment. For example, Yu. N. Perevalov feels that "a brake is for the time being the absence of a sufficient quantity of the necessary computer hardware and primarily of terminal units for operating on communication lines under shop conditions and reliable computer peripherals."

5. What can you say about the effect of modern ASU? Is there conformity between the calculated and actual effect due to ASU? What is your attitude toward the existing method of calculating the efficiency of ASU? Is development of a new method required?

In the general opinion of the participants, ASU proved their necessity and usefulness at all levels of management of the national economy--from individual production processes and enterprises to ministries, departments and central planning economic organizations. They have already become an indispensable part of the management systems, which V. B. Bezrukov, N. G. Belov, V. V. Yevdokimov, G. M. Sokolov, B. V. Prilepskiy, B. Ye. Trinchuk, Yu. I. Tychkov, Yu. M. Cherkasov and others emphasize.

The main effect due to ASU is still determined by supporting the management processes with modern and sufficiently reliable information and also with the possibility of conducting mass "direct" computations. Only in some cases are ASU used in solution of optimization problems and in the interactive mode for improving the substantiation of management decisions themselves.

At the same time, the participants expressed dissatisfaction with the actually achieved level of the effectiveness of existing ASU. B. Ye. Trinchuk estimates their actual efficiency at 25-30 percent of the calculated (planned) efficiency. B. Yu. Blazhis presents typical figures from the results of a questionnaire conducted in the Lithuanian SSR at a number of industrial enterprises: the return of investment of ASU fluctuates from 0.8 to 20 years; the calculated saving comprises no more than 80 percent of the planned saving; almost half of all the problems designed for solution in ASU is actually not used.

F. I. Rudnik presents somewhat more optimistic data on the Frezer Plant, where many years of experience have been accumulated in operation of ASU. As he notes, the calculated return of investment fluctuates from 0.35 to 0.57 year for a number of enterprises of Minstankoprom [USSR Ministry of Machine Tool Building and Tool Industry], which have ASU available, but it is actually 1.1 year higher; the saving is an average of 300,000 rubles, but it comprises no more than 30-40 percent of the potentially possible saving in the case of constructing a system of a higher scientific and technical level.

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The impression is created that ASU now operate comparatively more efficiently at the lowest level of control (ASU TP) and at the upper levels (at ministries, departments and central planning-economic organizations, where development of ASU has mainly been completed). Matters are relatively worse with ASUP [automated enterprise management system], which is also reflected in the rates of developing new systems in this level of managing the national economy, which the data of the table indicate.*

Number of Developed Automated Systems**

Types of ASU	1971-1975	1976 -1980	1981	1982	1983
ASU TP	113	261	320	376	527
ASUP	168	78	59	49	57

This situation is explained to a significant degree by the fact that ASU TP are designed in a unit whole with the object itself--the production processes themselves, and the problem of "building them in" during management either does not occur or is successfully overcome. Each sector or department ASU is developed individually and only a few of the best developer forces participate in their design and introduction. These forces are clearly insufficient for mass development of ASUP (i.e., more complicated and multifunctional systems compared to an ASU TP). As B. I. Fomin validly emphasizes, cottage "piecework" brings no saving here, design and introduction of ASU should be postulated to an industrial base, typical solutions, standards and a standardized technical base are necessary and so on.

Deficiencies in design of ASU were brought about by not always reasoned orientation of them toward one or another range of management problems as the primary object of automation, their breakdown into autonomous parts, the absence of the necessary information for solution of the planned tasks or multiple duplication of it in separate "task by task" files. An important cause of the low efficiency of a number of ASU, as A. G. Mamikonov notes, is their inefficient technical and organizational support. It also causes difficulties which are encountered in multiplexing tasks, in integration of data processing in separate ASU and, moreover, in organization of information contacts between different systems.

With regard to the existing method of calculating the efficiency of ASU, almost all participants of the discussion expressed their negative attitude toward it. It is mainly related to the impossibility of clearly defining to what degree the work of the ASU improves the final results of the activity of the object being controlled. Moreover, the method usually requires evaluation of the contribution of the ASU in quantitative volumetric indicators (an increase of profit, reduction of cost and so on), which sharply constricts analysis of the sphere of the real effect of the ASU. In the opinion of

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* "Narodnoye khozyaystvo SSSR v 1983 g. Statisticheskiy yezhegodnik" [USSR National Economy in 1983. Statistical Yearbook], Moscow, Izdatelstvo "Finansy i statistika", 1984, p 104.
** Average per year in period - editor, CCAT.

G. V. Oboladze, one should recognize with this approach, for example, that the complex of tasks, awarded the medal of VDNKh [Exhibition of Achievements of the National Economy], on quality control in a sector ASU as ineffective, since it did not lead to direct improvement of the named indicators; a saving due to an increase of product quality, as Yu. N. Perevalov validly indicates, is achieved by its users, while the cost may also increase in some cases for the producers. Nevertheless, the existing method does not take into account the positive consequences of introducing ASU in the management system itself—changing the nature of labor of workers, improving the flows and reducing the volume of data to be processed, social effects and so on (A. M. Vaynzof and others emphasized this).

Many specialists, for example, R. Ya. Levita and S. Ye. Petrova, assuming that the designation of an ASU is information servicing of the management process, sees in this the well-known analogy of these systems to communication devices. "It is clear to everyone," emphasizes A. G. Mamikonov, "that the modern manager cannot work as efficiently without a telephone, but no one has ever tried to estimate its economic effect in rubles and kopecks." Nevertheless, A. G. Mamikonov and also V. L. Makarov and some other participants still feel it is possible to estimate the economic effectiveness of ASU. They propose that the corresponding calculations be made, beginning with individual tasks and complexes of them.

The general conclusion reduces to the fact that the existing method requires coherent principal revision. A new method of evaluating the effectiveness of an ASU, which fully takes into account the specific features and functions of these systems in the modern national economy (possibly made more specific in a series of sector methods and also methods on management levels—for production processes, enterprises and associations, ministries, departments and territorial organizations), is required.

Essentially, as A. A. Vasilyauskas, B. A. Volchkov, L. V. Kantorovich, D. Kh. Karimov, V. L. Makarov, B. V. Prilepskiy and others point out, the main sources of a saving from introduction of ASU are: mechanization of labor-consuming calculations, support of personnel making decisions with timely and sufficiently complete information and the possibility of setting up and solving new classes of problems, primarily optimization and balance problems. The scale and ratio of these effects are different in each real ASU, but they all deserve careful quantitative or at least qualitative evaluation in design and introduction of these systems. Integration of different ASU into a unified system of the OGAS [Statewide automated system for collection and processing of information for accounting, planning and management in the national economy] type, which opens up the possibilities of direct, intermachine exchange of information. All these sources of a saving should be specifically reflected in the method. At the same time, the corresponding recommendations should be coordinated with each other and tied in to the general method of evaluating the effectiveness of capital investments and other economic measures.

6. What problems of improving the economic mechanism most timely for increasing the effectiveness of using ASU?

Development of ASU is an organic constituent part of the process of improving the economic mechanism and, as V. B. Bezrukov and Yu. M. Cherkasov emphasize, should be considered in harmony with this process. In the final analysis, the designation of an ASU is to contribute to an increase of the quality of management of the national economy and its sections, primarily, of scientific substantiation of decisions made. L. V. Kantorovich points out that ASU permit one to carry out more extensive economic analysis and to obtain more adequate information to make management decisions. V. L. Makarov distinguishes intensification of monitoring the fulfillment of decisions and plans, an increase of online decisions in dispatching (especially in supply, power engineering and transport), the use of interactive systems to formulate production plans, innovation programs and so on.

At the same time, it was noted that improvement of the economic mechanism is the key to increasing the effectiveness of ASU. One of the veterans of developing information management systems, Yu. I. Chernyak and many other participants, emphasized this. A specific management skill and bringing order in production—in normalization, organization of labor, accounting for losses and so on, are primarily required for normal operation of an ASU. As Yu. N. Perevalov feels, such is the initial functional prerequisite of an ASU.

The economic mechanism should develop an interest in improving the quality of management and should stimulate economic managers toward efficient use of computers. It is well known, for example, that evaluating the operation of automotive enterprises by ton-kilometer does not contribute to calculation of optimal shipping plans that minimize the total mileage of vehicles using ASU. A. G. Mamikonov and V. S. Sinyak turn attention toward another aspect of the problem, related to evaluating the operation of the means of automation of management themselves. The fact is that, according to instructions of Minfin SSSR [USSR Ministry of Finance], the calculated (planned) annual saving due to ASU has been connected to the profit achieved by the enterprise (sector) during the past 2 years, approximately 50 percent of which is deducted to the budget. The mentioned specialists fear that this may "stimulate" a decrease of interest to introduction of ASU. Moreover, a value of 0.33-0.5 with return of investment of 2-3 years has been established for the normative coefficient of the economic effectiveness of capital investments with respect to computer technology, whereas it comprises an average of 0.15 (return of investment of 7 years) for similar types of equipment. Naturally, these measures lead in some cases to rejection of inefficient designs, but the misfortune is that the basis of decisions made are formal and moreover not too reliable indicators.

In the final analysis, an increase of the economic return of ASU depends considerably on the interests of economic managers and labor collectives in mobilizing all internal production reserves, on the one hand, and in the economic feasibility of using ASU for these purposes, on the other hand.

7. What are the directions of development of ASU you feel are most promising?

The organizational forms established up to the present—enterprise ASU, sector ASU of ministries and departments and central planning-economic organizations (ASPR [Automated control system for planning calculations], ASGS [Automated

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system for state statistics] and so on), as L. V. Kantorovich feels, will also be retained in the future. Special attention should be devoted to development of ASU in the sphere of public services--in commerce, health, support of consumer information, which will also contribute to development of the appropriate "psychological climate" for these systems as a whole.

However, significant qualitative changes should occur in the content of the work of ASU. In the opinion of the participants, it will be developed along the following basic directions.

First, ASU must be organically tied to the lowest, basic level of the management system by automation of production processes themselves. Accordingly, flexible automated plants (GAP) and automated production process management systems, automation of the workstations of engineers and management personnel should be developed and computer-aided design systems (SAPR) and automated systems for technological preparation of production (ASTPP) should be developed. All this is called upon to provide a new quality of the management process and "computerization" of it; the interactive mode of communicating with computers will acquire ever greater significance in the work of managers and engineers for obtaining and analyzing information, calculating the versions of solutions and so on. V. V. Yevdokimov, A. A. Pervozvanskiy, F. I. Rudnik, B. Ye. Trinchuk, Yu. I. Tychkov and others emphasized this.

Second, data processing should be integrated in each ASU on the basis of automated (or integrated) data banks (ADB) and one should strive in every way toward direct input of information into the system from "primary sources" by using the appropriate pickups, peripherals and so on and one should reject if possible batch processing of data and individual storage of data in "task" files. N. B. Mironosetskiy feels that an important condition of such integrated systems is their adaptability and realization on dispersed computer capacities.

Third, the investigations in the field of integration of the ASU themselves must be activated along the "vertical" and "horizontal" of management or at least organization of information exchange between them, especially for solving multiple, intersector problems (N. G. Belov, A. M. Vaynzof, A. A. Vasilyauskas, V. L. Makarov, M. T. Matveyev, G. V. Oboladze and G. M. Sokolov substantiated the significance of the second and third directions).

As B. I. Fomin validly emphasized, the entire matter of design and introduction of ASU must be placed on a modern, clearly industrial basis to realize the indicated problems of developing ASU, having created a new sector of the national economy--informatics. It should specifically provide typical and systematic design of the ASU by its nature in organic harmony with this object (Yu. I. Chernyak emphasized this), development of the appropriate standards, standardized forms, classifiers, typical technical modules and so on (D. Kh. Karimov). In this regard B. I. Kruglikov pointed out the significance of the Unionwide Classifier of Technical-Economic and Social Indicators (OKTESP), which Gosstandart SSSR [USSR State Standards] confirmed and introduced in 1985 with force of a GOST [state standard] as a unified language, compulsory in the USSR, for intersystems exchange of quantitative data within OGAS.

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8. Is a change of the organizational structure of management an obligatory condition in development of ASU? Are units or subsystems, relatively independent from change of the organizational structure, possible in ASU?

Most specialists feel that development of an ASU does not require significant modifications of the organizational structure of management of the national economy, although it does contribute toward making it more efficient and to bringing order to the information contacts between individual sections of the management system. V. B. Bezrukov, B. Ye. Trinchuk and Yu. I. Chernyak occupy a more decisive position, who feel that a change of the organizational structures is obligatory in further development of ASU, especially with regard to development and extensive distribution of GAP [flexible automated plant]. These fundamental changes in the management object inevitably require improvement of the organization of management in the broad sense of the word, including distribution of functions, rights and responsibility and information. Kh. O. Repp points out that the structure of the management apparatus in separate sections of the national economy will also change. B. V. Prilepskiy feels it is feasible to introduce in some cases a production dispatcher service at enterprises with employees that work directly with ASU terminals. Implementation of the proposal already mentioned by B. I. Fomin on creation of a new sector—informatics—also requires changes in the organizational structure.

A. M. Vaynzof, L. V. Gigineyshvili, V. L. Makarov and N. B. Mironosetskiy turn attention to the significant changes of individual functions, the nature of work of management personnel, organization of document circulation and generally of information flows in the management system of the national economy at all its levels. O. V. Golovanov makes the valid generalizing conclusion: "The need to change the organizational structure depends on the degree of automation of management functions or of the combination of them."

9. How do you evaluate the prospects for combining local automated systems with upper level ASU into integrated ASU? What are the possibilities of information exchange between ASU of different departments and enterprises "along the horizontal"?

The problem of integrating automated management systems is recognized by all specialists as vitally important. Solution of it permits one to turn to a new phase in development of ASU as a whole and provides the basis for fundamental rearrangement of the information relationships and for organization of the management of economic objects. The opinion is expressed that development of multilevel complexes of integrated ASU is a general direction in development of automation of management and that it is integration of ASU that should provide the main component of the national economic effect due to introduction of computer technology (G. M. Sokolov and Yu. M. Cherkasov). However, a specific phase nature in solution of this problem is necessary.

Integration is necessary where its greatest effect is manifested (O. V. Golovanov). Specifically, solution of information exchange problems between ASU of different enterprises is acutely needed to bring order to the "supplier-user" relationships (Yu. N. Perevalov) and to solve other interdepartmental

management problems, especially of an operational nature (M. T. Matveyev). Integration of the relationships between the automated statewide statistics system and sector ASU (this process is rather called automation of information exchange) in the field of processing the statistical accounting of enterprises alone would permit a reduction of document flows, would reduce the laboriousness of data transfer to machine storage devices on countrywide scales and would concentrate the resources of the OASU [sector automated management system] in planned and control-analytical tasks (A. A. Vasilyauskas and G. V. Oboladze). An important role is given to integration of ASU from the viewpoint of realizing multistep iterative processes of balancing in planning calculations as well (B. A. Avrov and A. A. Vasilyauskas).

At the same time, the participants noted a number of obstacles in the path of realizing the concept of integrated ASU. It is first of all impossible to recognize as sufficiently debugged   organizational, economic, technological and information contacts between all institutions, for which ASU integrated into a single complex are created. The problem of providing with hardware, software and mathematical interfaces between ASU remains acute (B. Ye. Trinchuk and Yu. M. Cherkasov). There is no one constructed theory on the problems of integration and therefore they are solved empirically by the trial and error method (V. B. Bezrukov). As a result, the systems were essentially unprepared for intermachine exchange of data either with respect to the content of the problems to be solved or with respect to the information and technical-production characteristics (A. A. Vasilyauskas and G. M. Sokolov).

Integration of ASU, especially "horizontal" integration," is closely related to solution of problems of improving the economic mechanism. Departmental dispersion determines the small volume of information exchange and it also creates great difficulties in the organizational respect: it is just as difficult to combine the ASU of different VPO [All-Union Production Association] within one sector as it is to combine their garages and warehouses (V. V. Yevdokimov and Yu. I. Chernyak). In this regard, some participants have expressed the opinion of the economic feasibility of managing the broad front of investigations on "horizontal" integration of ASU. It is clear that these factors may also prevent "vertical" integration.

However, gradual development of information exchange between ASU "along the horizontal" is necessary to work out and establish the technology of interaction in the future. Assume that these data flows are still insignificant and assume that they do not currently make a significant contribution to the total increase of the effectiveness of ASU, but they will gradually increase and, moreover, the interaction of different ASU will stimulate not in words, but in deeds the solution of problems of "horizontal" integration of ASU (G. M. Sokolov). Moreover, horizontal information exchanges, provided there is sanctioning of transfer of each specific portion of it by the management apparatus, are already being carried out, but only the problem of data preparation on computers, which does not provide multiple reduction of transport periods, is being solved for the time being (O. V. Golovanov).

Some participants feel that the necessary prerequisites at the sector level already exist for vertical integration: information flows, transmitted by one

or another technology between management levels, already circulate in any OASU; an attempt is usually made within sectors to achieve compatibility of information support and software (G. M. Sokolov).

An optimistic evaluation is advanced with respect to the capabilities of integrating ASUP, ASU TP and other subsystems at an enterprise. At the same time, two serious obstacles in this matter are noted. First, hardware and software, which are used to implement different components of the system, are usually developed autonomously by different organizations. Therefore, the problem of a software-hardware interface between components is solved slowly, which makes the processes of their integration difficult. Second, to develop a genuinely integrated ASUP, all types of production and management processes at the enterprise must be automated. Otherwise, one can talk about some intermediate status in integration in the best case. However, continuous automation at an enterprise is now an extremely complicated problem.

Therefore, along with the technical aspect of combining local ASU into an integrated system, there is also another very important aspect--organizational. In the opinion of B. V. Prilepskiy, it would be efficient to concentrate the efforts of developers at some basic enterprise of the sector to solve these problems, having allocated to it the necessary resources and broad rights for making up the staff and for establishing contract relationships with scientific research institutes and planning institutes.

Thus, the problem of integrating ASU both "along the horizontal" and "along the vertical" is timely and solution of it is of important national economic significance. At the same time, it has not been worked out sufficiently thoroughly either in the theoretical and practical sense, which, under conditions of the continuing deepening and broadening of investigations in the field of ASU, is related to an increase of difficulties in joining automated systems.

10. What types of economic-mathematical models are more promising for broad use in ASU? What do you see as the reasons for insufficient use of optimization models in ASU? What should be done to accelerate specific changes and what should they consist of?

L. V. Kantorovich gave the clearest answer to the first of this group of questions. He feels that models are most promising for widespread use: arrangement of production, future planning, current planning and specifically arrangement of the production program, management of transport flows and future development of the transport network, management of agricultural production and procurement, intraplant activity and production time tables and schedules. N. B. Mironosetskiy, V. S. Podkopayev, B. V. Prilepskiy, G. M. Sokolov and others agreed with the opinion of L. V. Kantorovich. Many specialists noted that, besides optimization prospects, all types of simulation models have great prospects in ASU.

We are of course talking about solution of the corresponding planning and management problems on the basis of using optimization models rather than about introduction of models as such. As L. Z. Sheynis pointed out, attempts

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to introduce an optimization model (rather than a task) within the framework of ASU and to provide a stable process of operating it are always unsuccessful. The optimization problem, according to L. Z. Sheynis, includes: the optimization model, software for the system of computations (including PPP [applications program package] for computations by the model), the corresponding instructive-operating documentation, the necessary and previously developed information support and measures realized by the moment of introduction on preparation of the object for industrial operation of the optimization problem.

Many participants (V. B. Bezrukov, L. V. Kantorovich, A. S. Redkin, G. M. Sokolov and others) discussed the importance of an integrated, systems approach to realization of optimization computations. Being a powerful tool, optimization methods cannot exist outside the entire multifaceted process of planning and management. On the contrary, organizational procedures must frequently be rearranged, the system of personnel training must be changed, the composition of economic indicators must be improved and so on (A. M. Vaynzof).

However, practical realization of this path is related to serious organizational and production rearrangements in the management system. The need to make these rearrangements and also the lack of readiness of organization managers to take on this complicated, but important matter inhibits the introduction of economic-mathematical methods (S. B. Mikhalev and G. M. Sokolov). A similar contradiction must also be overcome at the mid-level of management, at the level of executors, whom one or another changes touch (A. M. Vaynzof and B. V. Prilepskiy). The imperfection of the existing economic mechanism also hinders the practice of introducing optimization computations.

The effectiveness of optimization computations was considerably lower than expected due to the fact that the developers frequently underestimated the complexities of the economic mechanism in general and of the process of working out the plan specifically. Compilation of the plan is a creative act, in which information difficult to formalize plays the main roles; the mechanism of combining the requirements of optimality and reliability is not very clear and the practice of planning differs sharply from existing instructions; therefore, one can talk about two planning mechanisms--the real and normative. Everything is constructed in an ASU on the basis of the latter mechanism and the results are unacceptable for practice (L. G. Golub and B. V. Prilepskiy).

High hopes are being placed in this regard on providing active interaction of the planning worker and the model, which would permit him to develop a rational strategy of production-economic activity (B. V. Bezrukov, B. A. Volchkov, V. V. Yevdokimov, D. Kh. Karimov, V. L. Makarov, A. S. Redkin, Yu. I. Tychkov and others). L. G. Golub emphasizes an important position: the person making the decision is usually guided by his own "mental" model, which represents the conditions for implementing the plan, but problems related to providing the manager with information for formulating a "mental" model are usually not considered in an ASU. The result is the manager's intuitive dissatisfaction with the plan achieved by means of a computer and a desire to repeat the calculation manually and a conflict between the machine and manual versions. However, implementation of this approach is related to the need to accelerate

investigations in development of high-speed data transmission systems and networks and in introduction of telecommunications methods and interactive modes of user communications with the computer (G. M. Sokolov). The ratios of mainframe, mini- and microcomputers and also of terminal devices requires review.

According to Yu. N. Perevalov, this ratio should be close to 1:10:100:1,000.

Solution of the entire complex of problems will undoubtedly contribute to introduction of optimization methods. V. V. Yevdokimov thus outlined the situation: "When a user sitting behind the terminal of a personal computer can assign different criteria or can introduce additional restrictions and thus obtain the necessary solutions on the display, optimization methods will become an indispensible management tool."

Conversion to essentially new methods of substantiation and adoption of planning decisions is being delayed not only by the limited capabilities of available hardware but also by deficiencies of existing model apparatus (B. V. Bezrukov). The limitation of optimization problems in linear postulation is frequently discussed. Twenty years of experience in development, introduction and organization or industrial exploitation of optimization problems in the fishing industry permits one to state that linear models, at least in some cases, completely satisfy the main requirements of sector planning with regard to all levels of management (L. Z. Sheynis). V. S. Podkopayev supports this viewpoint with respect to optimization problems for production plans at the enterprise level.

The answer to the question of the main causes of insufficient use of optimization models in ASU can be supplemented by a list of causes presented by L. Z. Sheynis.

1. Overstated requirements on the capabilities of using optimization problems and unclear interpretation of the results of computer calculations in formulating the drafts of plans for economic facilities of different levels and reevaluation of the "optimality" and underestimation of "balance" of the results of planning calculations, made by means of optimization problems.

2. Nonconformity between the existing system of planning indicators and indicators for evaluation of production and the formats of representing the results of solving optimization problems.

3. Excessively simplified or too complicated nature of models to be used.

4. Insufficient preparation for introduction, the low level of organization of industrial exploitation and the absence of preliminary scientific investigations for introduction and organization of industrial exploitation.

5. The low level of automation of all technological data processing in solution of the optimization problem.

6. Deficiencies in methodical support and formalization of calculations of plans implemented by the traditional method.

7. Complexity and laboriousness of investigation, development and introduction of optimization problems and the absence of interests of developers in being involved in postulation and solution of them.

8. Frequently combining a broad complex of planning-economic and management calculations in the optimization problem, by which there is no unified client --a functional subdivision--in the apparatus of the ministry (association) as a whole.

9. The complexity and laboriousness of preparing information support.

B. A. Volchkov and B. Yu. Blazhis add:

10. Failure to solve problems of increasing the level of training of planning workers and regulating their functions in the use of optimization calculations.

What must be done to accelerate feasible changes and of what should they consist? The participants are unanimous here: the enumerated negative factors must be eliminated sequentially, persistently and purposefully.

The experience of developing optimization systems in separate sectors and at enterprises indicates that the difficulties arising in introduction have been overcome (B. A. Avrov, A. M. Vaynzov, L. G. Golub, L. Z. Sheynis et al.).

11. What methodical problems of economic-mathematical modelling are most timely for accelerating the use of economic-mathematical models in ASU?

L. V. Kantorovich feels that the most timely among the methodological problems are: 1) the adequacy of the models of reality, 2) the use of optimal values of dual estimates from problems of a higher organizational level in schedule management and in formulation of economic indicators, 3) information support of optimization calculations, 4) the robustness of models to incompleteness and inaccuracy of input data, 5) combining models with existing organizational-economic conditions and 6) scientific methodology of introduction.

Other participants added the following directions of investigations to this list: 7) working out combinations of simulation models that include the apparatus for optimization and that are oriented toward the use of man-machine interaction (D. Kh. Karimov, G. M. Sokolov, Yu. I. Tychkov and others), 8) multipurpose optimization and methods of searching for quasi-optimal solutions (Yu. N. Perevalov), 9) determination of the most effective technology of constructing mathematical models for specific organizational systems that solve specific management-economic problems and primarily methods of systems analysis of the object of simulation (Yu. M. Cherkasov) and of the real economic mechanism (A. A. Pervozvanskiy), 10) solution of problems of simulating social processes, scientific and technical progress and of the economic mechanism (V. B. Bezrukov) and 11) identification of the types of production that permits one to select adequate models (V. M. Portugal).

12. What are the most timely directions for improving the systems software of ASU? Which problems of development and distribution of ASU and of increasing their results can be solved by developments in systems software?

Most participants feel that the situation in the field of systems software of ASU has improved during the past 10 years after the first roundtable meeting. Distributed database management systems, technological data processing systems, problem- and functional-oriented applications program packages, interactive systems and so on have been developed and are being actively developed (B. V. Bezrukov, V. V. Yevdokimov, L. V. Kantorovich, V. M. Portugal, B. Ye. Trinchuk, Yu. M. Cherkasov and so on). An acceptable batch mode of ASU functioning could be provided in most cases (V. B. Bezrukov, M. M. Matveyev, G. M. Sokolov and others). The fraction of typical planning solutions, based on standard software, increased (B. M. Portugal and Yu. M. Cherkasov). The level of "mass" development of ASU, including programmers, was also increased (V. B. Bezrukov).

However, all the participants hold the common opinion that the level of software lags behind present requirements, without even talking about the future. Thus, M. T. Matveyev feels that the "programs hunger" of existing and developed ASU has only been intensified during the past few years, while constructive methods of solving the problem have thus not been found. The list of deficiencies in the field of developing systems software, which the participants present, confirms this. Let us enumerate the main ones of them.

1. Direct access to data and the tools for processing them should be provided in modern ASU to the workers of the management system. This can be accomplished by intellectualization of the systems software of ASU and by introduction of personal (individual) means of data access at the workstations of managers, technicians, designers, production workers and employees, which would permit these workers to interact with the computer without intermediaries (K. P. Glushchenko, D. Kh. Karimov, B. I. Kruglikov, V. L. Makarov, S. B. Mikhalev, G. M. Sokolov and others).

2. One of the important problems is to develop flexible software that makes it possible to realize problems of different class in the systems, to formulate software easily from separate modules for complexes of problems that describe complicated production-economic situations and to integrate organizational ASU with computer-aided design systems and automated production process managment systems (V. V. Yevdokimov, D. Kh. Karimov, B. L. Makarov, M. T. Matveyev, B. V. Prilepskiy and F. I. Rudnik). Modern applications program packages do not properly meet the enumerated requirements. Development of complexes on the basis of existing applications program packages that describe complicated production-economic situations sometimes requires greater expenditures than even individual programming, i.e., it is sometimes easier to develop a new applications program package than to integrate an existing one (V. V. Yevdokimov and B. Ye. Trinchuk).

3. A timely direction for improving systems software of ASU is development and introduction of developmental problem-oriented systems with developed language aids, designed on the principles of standardization and typification

(V. L. Makarov, V. M. Portugal and Yu. M. Cherkasov). Too little has been done in this field: unified requirements on standard software for different ASU have not been worked out and there is no effective method of selection between individual or typical software for a specific object.

4. Serious complaints are placed on the quality of software and on its compatibility with hardware (V. B. Bezrukov, N. G. Belov, B. Ye. Trinchuk and others). Thus, B. V. Bezrukov notes that "many program products accepted for distribution have not been brought up to their proper level, contain a large number of errors and are poorly documented." All this leads to the fact that program developments cannot essentially be exploited without recruiting the people that developed them. The problem of "support of software, i.e., timely correction of detected errors and announcement to all users about changes made." Another important problem consists in the fact that "delivery of system-wide Soviet software lags in time behind the receipt of the corresponding hardware. This is especially true of modern methods of program development and debugging, computer exchange support aids and telecommunication aids."

5. Upon conversion from "local" systems to integrated systems that combine different management entities, the principal problem of security against unsanctioned access to the data to be processed and transmitted by the software arises; this problem has essentially not been solved in practice (M. T. Matveyev).

6. The level of the "mass" developer of ASU, including programmers, is still low (although, it has changed for the better, as was already noted).

Which most timely directions for improving the systems software of ASU were proposed by the participants?

1. Developing program complexes and packages for systems and network teleprocessing.

2. Developing protocols and interfaces for interaction of processes.

3. Preparation of service complexes and program packages that provide text editing, processing and input-output of graphic data, spoken data input-output and so on.

4. Design of a man-machine language, natural in format, that permits the capability of machine realization and that can provide direct communication of the non-programmer with machine (intelligent) systems in the interactive mode.

5. Development of flexible software and of applications program packages on the basis of standardization and typification of problems and management decisions.

6. Formulation of a system for centralized planning of production and use (including maintenance) of software based on the principles of creating a State fund of algorithms and programs and coordination of the efforts of program developers.

7. Preparation of methods of selecting those packages from available applications program packages which correspond to the characteristics of a specific object.

8. Development of software for security against unsanctioned access to the data to be processed and transmitted.

9. Increasing the skills of programmers who develop mass software.

13. Do you feel that fourth-generation computers are adequate for the purposes of ASU in the national economy with respect to basic technical characteristics?

Most participants (V. B. Bezrukov, A. G. Mamikonov, M. T. Matveyev, Yu. N. Perevalov, B. V. Prilepskiy, Yu. M. Cherkasov and others) feel that fourth-generation computers are adequate in their technical characteristics for the present goals of ASU, but practical realization of these capabilities and especially the reliability of hardware lag far behind the necessary level (A. G. Mamikonov). Practically all the participants agree with this viewpoint. Thus, M. T. Matveyev writes that "USSR Gosplan, ministries and departments should finally organize the output of reliable hardware, primarily of of computers, which would be ready and started in weeks rather than months and which would not require plant modifications at the installation site." Weak technical and organizational support is one of the main factors that delay mass development and use of highly effective ASU.

But it is not enough to have a powerful processor, a sufficient number of peripheral devices and primarily of disk units, video terminals and computer communication equipment and that which provides telecommunications of users and computers are necessary for effective use of computers (V. B. Bezrukov, L. V. Kantorovich, M. T. Matveyev, Yu. N. Perevalov, B. V. Prilepskiy and G. M. Sokolov). But production of the enumerated units lags behind the requirement for them.

Personal computer have become more and more widespread recently for automation of the workstations of the management apparatus, but Soviet microcomputers are still inferior in technical capabilities to foreign models and are being produced in insufficient quantities.

The problem of hardware selection is also of important significance. "It is now clear that a computer network, consisting of a central computer center and numerous mini- and microcomput.rs, installed in shops, warehouses and in the departments of the enterprise, is necessary in full volume for automation of production management, even at medium-sized enterprises. Neither theory or approved methods of calculation nor standard schemas for these networks yet exist" (V. M. Portugal).

14. How does modern practice solve the problem of "specialization-standardization" in development of ASU? What reserves do you see here? How can they be mobilized?

Everyone who answered these questions feels that the problem of standardization of the elements of ASU and specialization of collectives of developers is the key for introduction of industrial technology of the development of ASU and for providing the development of highly effective and reliable control systems (V. B. Bezrukov, N. G. Belov, K. P. Glushchenko, O. V. Golovanov, V. V. Yevdokimov, L. V. Kantorovich, D. Kh. Karimov, V. L. Makarov, Yu. N. Perevalov, B. Ye. Trinchuk and Yu. M. Cherkasov). However, all the participants note that the problem has been insufficiently resolved until now and some even suggest that solution of it is unsatisfactory (K. P. Glushchenko, V. V. Yevdokimov and B. Ye. Trinchuk).

Three directions for "standardization" can be distinguished: standardization of organizational-economic planning decisions, development of standard software and standardization of data to be processed. "Development of standardization should begin primarily with management methods," feels V. L. Makarov; the basis for this "should be development of standard lists of management problems for objects of different levels," K. P. Glushchenko supports this viewpoint. "To do this," he continues, "systems analysis and structurization of the management functions are necessary with encompassing the entire complex of problems for improvement of management, making organizational structures and the economic mechanism, technology of planning and so on more efficient; and echelon support (for example, by the effectiveness of automation of problems) of problems of the typical list with standard planning decisions and standard software." One of the directions for standardization of planning decisions is "searching in different complexes for problems of similar algorithms to work out standard specialized programs. We are talking not so much about the models provided by different applications program packages as about so-called 'direct' planning calculations and also about the processes of logic checking of information and preparation and printing of output documents" V. B. Bezrukov).

Development of standard software is a second direction of standardization. A rather large number of applications program packages and statewide, republic, sector and other funds of algorithms and programs have now been developed, but their composition is random and incomplete, since there is no systematic purposeful makeup for industrial design of ASU (K. P. Glushchenko and V. V. Yevdokimov). Moreover, many applications program packages are incompatible with each other. These aspects do not permit one to completely design software by using them that is adapted to a specific object. The disadvantages may also include the absence of organizational documentation to the applications program packages in many cases.

The third direction is standardization of data to be processed. V. B. Bezrukov and D. Kh. Karimov share the positive experience of solving this problem in development of ASPR [automated management system for planning calculations]. They note that all data in ASPR are organized in the form of standardized planning documents while the texts are organized in the form of the positions of classifiers and references. This permits one to prepare systems software, common for all ASPR and to construct the functional technology on the specialization principle (each service executes its own sets of functions, but all work together with the same objects--standardized documents

and classifiers). The specialized data input and acquisition system Dokument has been established as the basis for standardization of documents in the ASPR, which made it possible to develop a unified information fund of the GVTs [main computer center] of USSR Gosplan on the basis of the OKA database management system for both numerical and dictionary information, to work out the technology for making calculations and to reduce significantly the time of software preparation. The most important problem in this field is to improve the technology of working with information on the basis of using modern hardware and software and extensive distribution of this experience in other systems.

Implementation of the three directions for standardization requires clearer separation of labor between participants of the process of automation and intensifying the coordination of their activity. Most participants feel that specialization of organizations of developers should be intensified: specialized planning organizations are obligated to develop primarily systems software and computer-aided design systems (structured and modular programming), while enterprises and sector institutes should primarily be involved in development of ASU and applications support (K. P. Glushchenko, O. V. Golovanov, V. V. Yevdokimov, V. L. Makarov and Yu. N. Perevalov). However, their views diverge on the specific problems of designing this system. Thus, V. L. Makarov feels that the main means of developing standardization and specialization is to centralize planning and management of the developers of ASU and of the developments themselves, while K. P. Glushchenko suggests a three-level scheme: the academic institutes specialize in methodological problems of automation, development of new methods and technology of management and economic-mathematical models, participate in development of standard lists of management problems, intersector and sector scientific research institutes specialize in compilation of standard lists of problems for different objects (and also for improvement of them) using the scientific results obtained at academic institutes and in practical testing of them in experimental ASU at host objects, and planning-design institutes and offices attached to sectors and objects specialize in design of systems on a standard basis.

Solution of problems of standardization and specialization will make it possible to convert to industrial design of ASU, which can be achieved by two methods. The first consists in standardization of design, which makes it possible to reduce the development of a system to assembly or configuration of finished applications program packages based on standard planning solutions. The most essential aspect is parametrization of the elements of planning solutions. The second method--computer-aided design--consists of using finished packages and design languages. As Yu. M. Cherkasov notes here, two promising directions have in turn been distinguished: development of integrated computer-aided software design systems and development of systems that provide contact of nonprofessional users with computers.

The desire for standardization should not hinder scientific investigation of the problems specific for a given object, since the ASU should be constructed according to specific conditions and with regard to the characteristic features which cannot always be realized by standardized modules (L. V. Kantorovich and Yu. N. Perevalov).

The idea of improving and enhancing the effectiveness of ASU as an important organic part of solving problems for improving planning and management and for acceleration of scientific and technical progress and intensification of the national economy as a whole was emphasized in both the answers to the questions and in the speeches at the roundtable meeting. Considerable attention was devoted to illuminating the experience and discussing timely problems of development and functioning of specific systems in many of the speeches following the survey reports. (To Be Continued)

6521
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PROGRESS IS SERVED   WHEN A UNIFIED SYSTEM OF SCIENTIFIC AND TECHNICAL INFOR-
MATION HAS BEEN CREATED

Baku BAKINSKIY RABOCHIY in Russian 15 May p 3

[Article by Professor D. Mekhtiyev, director of the Azerbaijan Scientific
Research Institute for Scientific and Technical Information and Technical and
Economic Research and member of the directors' council of the Association of
Scientific and Technical Information Systems of Transcaucasian Republics,
and R. Arakelov, section chief at the Azerbaijan Scientific Research Institute
for Scientific and Technical Information and Technical and Economic Research
and a member of the council of experts of the Association.]

[Text]   The creation of a network of automated information centers in Georgia,
Armenia, and Azerbaijan, each tied to the other, has immediately brought a
great advantage to all of its participants.   It has become possible, with
less expense, to satisfy the information needs of the three Transcaucasian
Republics more effectively and with better quality by means of coordinated
acquisition, transmission from one to another, and utilization of the docu-
mentation that they need.

Thus, our Azerbaijan Scientific Research Institute for Scientific and
Technical Information and Technical and Economic Research of the republic
Gosplan (AzNIINTI) itself directly purchased only 38 of 117 information files
on magnetic tapes that it needed in 1984.   The remaining 79, containing about
a million documents, came by way of exchanges from analogous institutes in
Georgia and Armenia.   In its turn, AzNIINTI transferred several hundred thou-
sand documents to the Association of Scientific and Technical Information
Systems of the Transcaucasian Republics.

The coordinated approach to the acquisition of information, so-called data
bases, has brought tangible advantage.   AzNIINTI alone has been able to re-
duce expenditures by more than one hundred thousand rubles.

One of the first important steps in this direction was, for example, the 1984
redistribution of enterprises and organizations of the region among informa-
tion systems of the three republics.   Thus, already a number of metallurgical
enterprises of our republic are served in the selective dissemination mode
of newly arriving information according to the corresponding topics of the
Armenian scientific and technical information system. At the same time, the
information system of our republic provides information to specialists of all
three Transcaucasian Republics on questions of petroleum producing and re-
fining.

Thereby, an approach is realized in which the enterprises of an industry that is not common in the economy of one republic are transferred to the information service of the scientific and technical information system of the republic for which that industry is common. It is obviously not difficult to notice that this allows each republic to concentrate efforts, rather than to scatter them, on the more urgent areas on which, among other things, sufficient experience already has been accumulated and there are qualified specialists.

Let us stay for a moment on the subject of the propagation of advanced experience. Thanks to the Association, the achievements of front-rank workers and of the shock workers of communist labor of labor collectives--the victors of socialist competition, rationalization proposals, and efficiency methods--in a word, all that is new to which engineering thought and workers' ingenuity give birth at the economic sites of one republic, becomes the property of the other two.

The information system of our republic has been designated the head organization to form data bases for advanced production experience for all of the Transcaucasus. In AzNIINTI is concentrated reference information on accumulated advanced industrial experience not only in Azerbaijan, Armenia, and Georgia, but also as a whole around the country. After systematizing it, AzNIINTI sends information to the region's enterprises that represents their interests.

At the same time, here they have also made all-union property of experience proven in localities in these republics. In 1984, for example, the Transcaucasian Association transferred into the general state system about 1,000 documents on advanced industrial experience, accumulated by enterprises of the region.

Cooperation among republic scientific and technical information systems is not limited to the aspects examined above--this list could be continued. However, questions of deepening business-like cooperation continue to remain on the agenda. They are examined twice a year at meetings of the directors' council of the Association. Also, the council of experts, formed from among specialists of the three republics' institutes of information, also operates highly effectively. Let us note, by the way, that the last meeting of these councils was conducted in Azerbaijan, and at that meeting, several very important decisions were made on the development of cooperation among the scientific and technical information systems of the Transcaucasian Republics.

Thus, it was decided to provide for the coordination of plans for the preparation and issuance of review and analytical information; to introduce a broad complex of works on standardization and classification of forms and methods for information support, and on the application of unified types of techniques for the organization of information processes, and of unified hardware and applications program packages; and to carry out a number of other measures aimed at providing dependable compatibility among all scientific and technical information systems of the Transcaucasian Republics. These decisions lay at the base of technical tasks for the development of our unified system of scientific and technical information for the 12th Five-Year Plan, approved by the Administration for Information and Scientific and Technical Propagation of the USSR State Committee for Science and Technology.

It should be especially noted that the realization of all this whole body of work is a highly complicated problem, requiring the concentration of the efforts of all three republic institutes of information. And not only of theirs. Progress, in large measure, is dependent on the large amount of various types of aid that is given to the Association by the head information centers of the country--all-union institutes of scientific and technical information, of patent information, of inter-industry information, and others. From them, the republic institutes of information, including AzNIINRI, receive prepared technical solutions for a number of processes, model packages of applications programs for automated processing, methodological and instructional aids for the organization of complex information support to economic sites . . .

At the April (1985) plenum of the CPSU Central Committee, it was noted that as a chief strategic lever for economic intensification and for better use of accumulated potential, the party places the cardinal acceleration of scientific and technical progress at the highest level. This is a task that is not only economic, but also political and moral.

The Association of Scientific and Technical Information Systems of the Transcaucasian Republics is still another manifestation of socialist integration. For workers of the information institutes of Georgia, Azerbaijan, and Armenia, efficient cooperation has become a real school of large-scale economic education.

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INFORMATION NETWORKS

[Article by Academician of Latvian SSR Academy of Sciences Eduard Yakubaytis, director of Institute of Electronics and Computer Technology, Latvian SSR Academy of Sciences]

[Text] Information networks are the basis of the modern data processing industry. They make it possible to create "electronic" institutions which are quite capable of operating without paper—the traditional data storage devices.

Each specialist—scientist, engineer and administrator—must now process large volumes of information, and he must primarily make the necessary decision. Computer technology helps him in this. However, the volumes of information required for processing and the requirements on the forms of accomplishing it are increasing continuously.

Development of a new science—informatics, involved in problems of processing various types of information, development of new highly efficient computer hardware, make it possible to offer users a wide range of different information resources.

The user interacts with the computer through a unit which has become known as the terminal. The terminal can be a telephone, teletype or electric typewriter. However, the most widespread terminal consists of a display (television screen and keyboard) and a printer. In any case, this is a device through which the user requests the necessary information, gives out jobs and the computer directs the necessary data to him and performs these jobs. The terminal has now become the working tool of the user.

Moreover, there is and never will be a super computer which can execute all the tasks required by the user: an increase in the performance of computers is in no way comparable to the increase of the volume of information servicing which an ever increasing number of user requires. Moreover, super concentration of information computing capacities in a single computer is simply economically unfeasible.

It is obvious that the information resources required by users should be distributed through a considerable number of computers. One of the computers will then have at its disposal a database, another will make the computations, a third one will support the work of the information retrieval service and so on. But in order for the user to work with all the information resources that he requires, he should have access to them. Moreover, resources located in a different computer may be required by the machine. For example, a computer making calculations may need data located in the database of a different computer. Therefore, computers should also interact with each other. And, finally, users wish to be able to transmit information to each other rapidly, by the electronic method. Therefore, communications between terminals must also be provided.

All three considered forms of interaction are provided by developing an association of computers and terminals, called an information network. It should be noted that networks were initially developed to make mathematical calculations and they were called computer networks. The term information computer networks then appeared. The term computer has gradually begun to disappear now when information work has become the main aspect.

The computer hardware complex, designed to process information, has become known as a system. The system includes one or several interconnected and compactly arranged computers, terminals and data transmission devices. Having connected the system to the communication subnet, we obtain an information network. The task of the communication subnet is to transmit data between all systems included in the network.

To increase the reliability of transmission, to simplify the structure of the switching subnet and to accelerate the travel time of messages, the computers forming the systems, prior to transmission of data, divide the messages into small parts, called packets. Packets are transmitted by their addresses through the communication subnet. Having received packets, the computers assemble the transmitted messages from them. Not only computer data, but also graphic images (drawings, figures and diagrams) and speech can be transmitted rapidly in packets.

Depending on the size (length) of the information network, on the number of systems to be used in it and on the operating modes of the computers and the required transmission speeds, different types of switching subnets are used. Let us consider two of them.

In those cases when the information network should have a long length (from 50 to 1,000 kilometers) or a considerable number of systems must be connected, the switching subnet consists of interconnected information switching terminals.
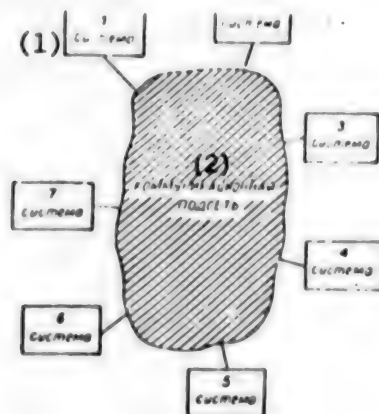
The number of terminals of the switching subnet are usually determine by the dimensions of the information network and by the number of computers operating in it. The channels between the terminals are laid so that communications between computers is not interrupted upon failure of any one of them. Each switching terminal consists of a large number of microprocessors, but its dimensions are small, to provide high operating reliability and high packet transmission speeds.

If the information network has a short length (up to 50 km) and if the number of systems to be connected to it is relatively small, the switching subnet has the shape of a unified monochannel for all computers, which is a coaxial cable and group of access units connected to it. Single-machine systems (computers) are connected to the monochannel.

The access unit to the coaxial cable is a simple apparatus and provides connection of the computer to the network. Not only coaxial cables, but a glass light guide (even more frequently) is used as the physical medium of the monochannel. The cable or light guide is connected to all the computers included in the information network.

Data in the monochannel are transmitted differently than in the terminal subnet. The packet transmitted by one computer, for example, at point 5 (see diagram), passes through the monochannel and reaches all the remaining computer connection points (the packet seems to be multiply duplicated). All the computers connected to the monochannel check the address of destination of the packet. The computer to which it is addressed leaves the packet. The remaining computers destroy the packet.

Thus, the terminal or monochannel switching subnet and computers connected to them provide interaction of any pairs of machines. The terminals are connected to the computers. Because of this, the user located at one terminal may have access to any computer of the information network, can work with any of its resources and can communicate with all the terminals existing in the network.


Structure of Information Network

Key:
1. System   2. Switching subnet

The number of terminals connected to the computers depends on the performance of the computers and on the tasks which are entrusted to them in the information network. If necessary, the number of terminals connected to one computer can reach hundreds. If only one terminal is connected to a computer, then it
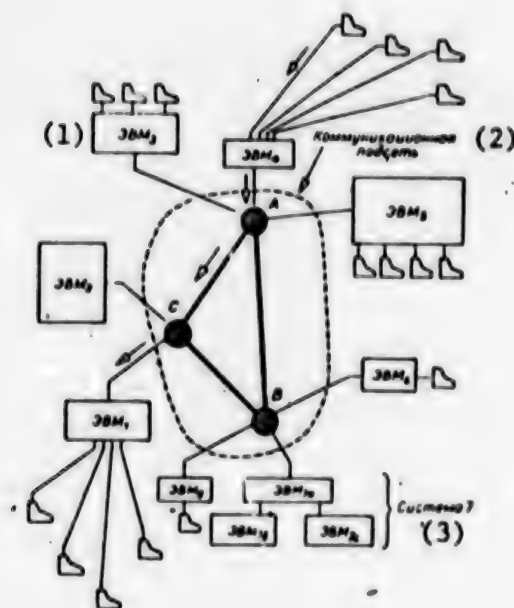
Information Network With Three Switching Terminals: switching
terminals A, B and C are connected to each other and to the com-
puter by data transmission channels. Systems 1-6 and 8 have at
least one computer, while system 7 consists of three computers.
The terminals are connected to the computer in the necessary
cases. Information is transmitted through the switching termin-
als between all the computers and terminals. The arrows indicate
the path of information from terminal A, belonging to computer 4,
to computer 1: Symbol ●--switching terminal; ──--data transmis-
sion channel; ◁ --terminal

Key:
1. Computer   3. System
2. Switching subnet

is essentially a personal computer. The computer frequently makes available
information resources to other computers and should interact with users only
through the switching subnet. The computer has no terminal in this case.

The work of users in the information network through personal computers is
becoming ever more popular. This is primarily explained by the low cost of
this computer. And which is even more important, it permits large computers
to operate in the network, regardless of other users and operating personnel.

For example, a system designed to operate in the information network simul-
taneously with a single user has been constructed on the basis of the Iskra-
226 computer. The central part of the machine is its processor and it is
located together with the display in the same housing. The printer and memory
of the computer--a magnetic disk--are located alongside. Thus, the user can
work with any computer included in the information network. Moreover, he can
on his own small computer:

Switching Terminal
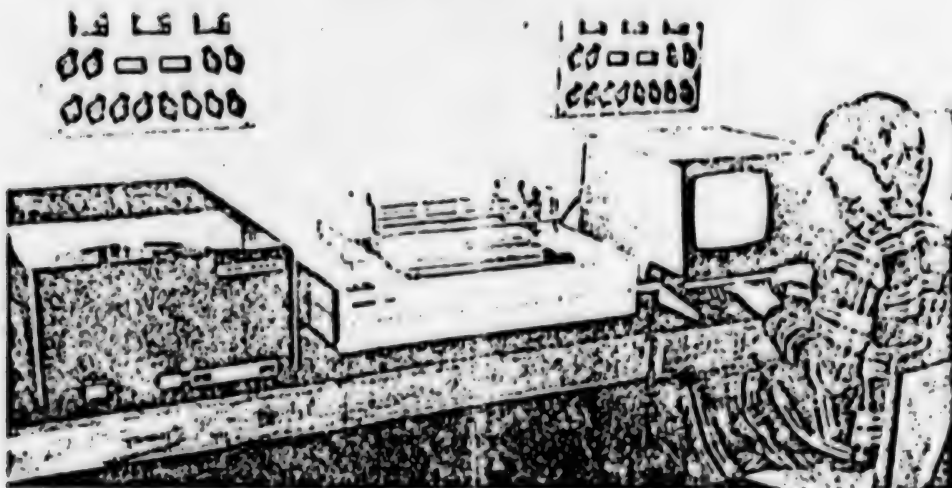
Iskra-226 Single-Terminal System

manage a personal document library;

prepare, edit and print letters, report titles and reports;

compile plans and keep a record of his own work;

organize small personal databases;

create drawings, diagrams and graphs;

prepare jobs for mainframe computers;

perform simple computations;

conduct teaching courses.

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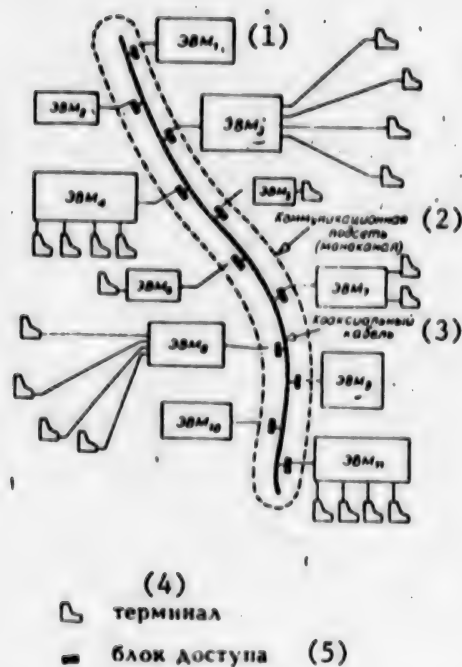
Information Network Designed on Basis of Monochannel

Key:
1. Computer
2. Switching subnet (monochannel)
3. Coaxial cable
4. Terminal
5. Access unit

User Room of SM-4 Multiterminal System

Medium-capacity computers are also used to provide interaction of users and the information network. There may be 5-15 displays in a multiterminal system, depending on the size of the computer (for example, the SM-4 computer). Because of this, the same number of users can work simultaneously in the information network.

The main information resources in the network are provided by mainframe computers. Thus, a large network data bank can be created on the YeS-1045 mainframe computer, operating at a speed of approximately one million operations per second, and a powerful computing service can be designed.

A four-terminal experimental information network, in which approximately 20 computers of different types--YeS, SM-4, Iskra-226 and Elektronika-100/25 computers operate--has been developed at the Latvian SSR Academy of Sciences. Information is transmitted through the switching subnet through microprocessor stations called network microprocessor adapters. The users of this network work with the following information resources: 1) database (an ordered set of a large number of documents which can be retrieved by specific features), 2) information retrieval (a service that provides acquisition, storage and retrieval of data contained in books, articles, patents, reports and other sources of information), 3) computations (a service that performs mathematical computations of any complexity), 4) electronic mail (a service that transmits and temporarily stores documents), 5) interactive development of software (development of new software in interactive mode), 6) teaching (a service that teaches users the methods of performing various types of operations), 7) management of plans, schedules and calendars (a work scheduling service performed by users) and 8) lists (a service that reports the necessary data to users). These resources are located in different computers connected to the network.

Development of information networks made it possible to provide a modern and highly efficient technical base for automation of scientific, design, production and administrative operations.

EDUCATION

PROBLEMS AND CRITERIA FOR UNIVERSAL COMPUTER EDUCATION

Riga SOVETSKAYA LATVIYA in Russian 18 Jun 85 p 2

[Article by Candidate of Pedagogical Sciences A. Smolyuk, director of Riga Secondary School No 74: "Universal Computer Education" under the rubric "On the Way to the School Reform"]

[Text] Widespread use of computers in the academic process and mastery of knowledge and skills in the use of modern computers by students are provided by the basic directions of school reform. The time has come when universal computer literacy of young students has become the reality of the modern school and an urgent task of pedagogical practice. New evidence of this is a conversation during a recent meeting of General Secretary of the CPSU Central Committee M. S. Gorbachev with teachers and studens of Moscow School No 514.

Computers have been used in teaching in our school for several years. What has this yielded? I would like to present the comments of our students.

"I solve a complicated system of equations within 30-40 minutes, but I can do this within 1-2 minutes using a microcomputer."

It is exceptionally interesting to "converse" with a display. One cannot be angry at the machine if it is not completely pleasant to you or gives you a "2," and then one can see the Brownian motion of molecules or the angle of flight of a missile on the display screen and only on it.

So students have willingly accepted computers. However, the problems of a universal computer education are still far from solved. The experience of our work convinces one of this. This was discussed in earlier published articles in SOVETSKAYA LATVIYA--"Studying Interactively With a Computer," and "The Computer in School."

Academician Yershov, one of the authors of training programs in universal computer education, defines two aspects in solving the problem: training of specialists in microprocessor technology during vocational training in school and arming all students with knowledge and skills which are required by the modern specialist at any workstation. We feel it is necessary to determine two additional aspects: psychological-pedagogical and material-technical aspects.

In our school, as in a number of other of the country's schools, specific experience has been accumulated in solving these and other problems in teaching students through the use of computers. Workers of the Latvian SSR Ministry of Education, the USSR Academy of Pedagogical Sciences, the Republic Institute for Teacher Advancement and pedagogues of Riga and our republic familiarized themselves with this experiment and approved it. The new subject "Fundamentals of Informatics and Computer Technology," proposed for the forthcoming academic year, was an integral part of the overall electronics program which was thoroughly studied in school and in special clases, while microcalculators or microcomputers with manual control were used by students in different classes, beginning with the fifth grade, as teaching aids.

I would first like to dwell on the material and technical aspect. The USSR Academy of Pedagogical Sciences proposes a three-version program of informatics and computer technology: the noncomputer version, the computer version and the version with thorough study of the given subject in special classes. But not all schools yet have identical capabilities of technical support. The host enterprises of our school are the Production Association VEF [Riga State Electrical Engineering Plant imeni V. I. Lenin], the republic computer center and the Scientific Research Institute of Electronics, Latvian SSR Academy of Sciences. They participate actively in development of the material base and correctly understand the meaning of overall responsibility for realizing the requirements of school reform.

Our previous experience indicates that the noncomputer version of studying informatics and computer technology can be rejected. We began to work with microcalculators 10 years ago when we did not have these host enterprises. Then, along with acquiring individual sets of microcalculators as teacher aids, we also utilized the increased interest of the students themselves in this equipment. Their desire was to have their own microcalculators in their classes.

It is not the acquisition and equipping of the academic process with technology that remains complicated (in the near future the needs of public education for microprocessor technology will be fully satisfied), but its use, maintenance and installation, and repair. It is sufficient to present this fact: the only Production Association Impuls accepts microcomputers from schools only after many persistent requests, while the teachers are still not ready to carry out independent installation, debugging and adjustment of computer hardware. One cannot get along here without engineering assistance of host enterprises. Since universal computer education is a statewide matter, I would hope that competent organizations will find it possible to solve the problem.

With regard to the psychological-pedagogical aspect, we would not be honest if we said that only teachers with special training and with the appropriate desires are capable of conducting lessons in computer education. Our leading teacher in computer education is Candidate of Pedagogical Sciences A. Revunov, who developed his own programs and manuals. Mathematics teachers N. Koldysheva and I. Tsygankova, chemistry teacher Ye. Zuyeva and military instructor Yu. Tokarskiy long ago overcame the psychological barrier and recognized the significance of computers in the academic process.

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The use of computers in extracurricular work has important possibilities: completion of exercises in productive labor, conducting competitions and olympiads in computers, manufacture and development of various types of devices with microprocessors and much more. If one talks about the pedagogical aspect of this problem, one should note that computer education provides a new level of thinking and a new level of the pedagogical process, standardized and more effective.

6521
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MOSCOW CENTER FOR TRAINING COMPUTER-TECHNOLOGY SPECIALISTS

Moscow VECHERNYAYA MOSKVA 10 June 85 p 2

Prilutskiy, A. (Interviewer)

[Excerpt] Computers are indispensable to economists, scientists, designers, agronomists, physicians and teachers. Computer centers are operating at many Moscow enterprises. They need programmers, operators and other computer-technology specialists who are trained by the special research-and-production association "Algoritm". P. Pupyrev, director of this association's Moscow research and training center, answered questions of our correspondent.

"How is the center's work organized?"

"The Moscow research and training center is one of 10 which are in charge of training specialists in the field of computer technology. I might add that it is the chief center and the largest one, and it has perhaps the best-qualified personnel. The center will graduate 4,500 specialists this year."

"Not everyone has the same computer literacy. Some have to learn the ABC's of computers, while others have some experience."

"This is certainly taken into account in making up groups of trainees and in the course of studies. We offer students the opportunity of receiving training in one of 11 professional areas and 150 fields of specialization, depending on their level of training and practical skills and the features of the work they are to do."

"Your courses are more than just theoretical ones?"

"Numerous teaching devices and simulators are installed in laboratories and classrooms. They are based on elements and units of modern computers. Moreover, they are replaced with newer equipment substantially faster than the stock of computers that are in service. The training of specialists in advance for computer technology that is still in the design stage and for new-generation computers is broadly practiced."

"Who can become a student of the center?"

"An employees of any industry who has to work with computers or will have to in the future. Enterprises send applications to their ministries.

"It must be said that the economy's requirements for specialists in the field of computer technology are outstripping our capabilities more and more noticeably. The Moscow center has practically no permanent base facilities. Classes are held in 20 places!

"The construction of a training complex is planned but has not been started. We hope that planning agencies will help expedite the solution of this question."

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